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To obtain a comprehensive picture of the state of play of ICT development and application in any given economy, the chapters on individual economies should ideally be read alongside the chapters on these economies in previous editions of the *Digital Review of Asia Pacific*, all of which are available for download at:

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*Asia*Pacific

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Contents

A. Regional overviews

B. Regional issues in ICT in education

C. Sub-regional perspectives

D. Review of individual economies

Foreword

The current edition of the *Digital Review of Asia Pacific* vividly paints the picture of a major dimension of change in the Asia Pacific region, and indeed in the world. Asia Pacific is my main concern at the Economic and Social Commission for Asia and the Pacific (ESCAP), but changes here and globally are quite similar. Communication and networking enabled by information and communication technologies (ICTs) are proving to be economically, socially, and politically transformative over time. For example, in both poor and wealthy countries, mobile phone use has been skyrocketing and facilitating the expansion of markets, social business, and public services. In fact, an entire range of economic services, enabled by mobile phones, has begun to emerge: micro finance and insurance, marketing and distribution (for example, farmers and fishermen connecting with markets, reduced distribution margins, and buyer control), employment services (for example, drivers and casual workers), personal services, and public services (such as telehealth and distance education). And beyond the economic impacts, improvements are being made in other freedoms or dimensions of well-being — personal security, political participation and accountability, social peace, dignity, and opportunity.

These developments are important, where they are thriving. But we should not forget the negative aspects and possibilities of communications-based transformation, such as mobile phones being used to fan violence, cybercrime and terrorism, and our vulnerability to disruption of communication. Nationally and internationally, control of communications is contended, and openness generally considered best. Internationally, the spread and appropriation of ICTs is a key globalization driver and knowledge carrier. In these circumstances, societies need to build communications systems and manage them well, develop infrastructure and the capacity to use it, and implement good policy and regulation. In the right environments, both business and non-profit enterprise are effective in rapidly expanding connectivity, using low-margin, high-volume business models. Affordable mobile Internet — smart phones and data services — exists today in wealthier societies and could be near universal in the next generation. These are stories that the *Digital Review of Asia Pacific 2009–2010* tells, in vivid and thoroughly researched detail, in snapshots as well as dynamic pictures of the development and use of digital storage, processing, and communications systems in 30 economies, with sub-regional and regional overviews.

Browse and be drawn into these pictures and narratives. Read previous editions of the *Digital Review of Asia Pacific* online to highlight changes and trends. In 2009 and 2010, partners of ESCAP, the International Development Research Centre (IDRC), and many other organizations will be monitoring the impacts of the global financial and economic crisis on economies, businesses and employment, public services and households, and identifying and carrying out key mitigation measures. Negative impacts spread through international 'transactions', falls in exports, remittances, foreign direct and portfolio investment, possibly official development assistance and, increasingly, transactions in knowledge. Impacts on digital systems and their users in particular could be substantially negative, arresting progress in economic and other spheres, with particular impact on the poorest. At stake in all sectors are advances in incomes, jobs, work, education, health, security, equity, and social functionality. Good management and responses, reported in the current and future editions of the *Digital Review of Asia Pacific*, will be central to reducing negative impacts. So enjoy, respond to, and do not miss the next editions of the *Digital Review of Asia Pacific*.

Noeleen Heyzer
Under-Secretary-General of the United Nations
and
Executive Secretary, ESCAP

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Preface

ICT FOR DEVELOPMENT IN THE ASIA PACIFIC REGION: RIDING THE WAVES OF CHANGE IN A 'FLAT WORLD'

The Grameen Bank in Bangladesh, one of the poorest countries of the world,
long ago made the choice to invest the present and the future of the poor in ICT.
ICT is a new opportunity for grassroots innovation.
I saw an opportunity for the poor people to change their lives
but only if this technology could be brought to them to meet their needs.
(Muhammad Yunus 2007)

The sudden onslaught of the current economic turmoil comes just when this edition of the *Digital Review of Asia Pacific* (DirAP) went to press and long after the authors had submitted their manuscripts. But the publishers, editors, and authors of DirAP will be closely monitoring the impact of this turbulence on the appropriation of information and communication technology (ICT) in the region throughout 2009 and 2010. Dr Yunus has showed the way to all who are working toward empowering poor communities, to address their development challenges through effective access to ICTs. At the same time, we are learning that even as communities adopt and use ICTs, it is imperative to track and understand the positive and negative effects of ICTs on specific communities. Each wave of global change impacts not only the international and regional levels, but also, more and more, poor rural households.

In the maiden 2003–2004 edition, we referred to DirAP as an analysis of 'a new type of public sphere [that is] more participatory and intentional'. That statement was made at a time when we had yet to see the real power of ICT. Since then, we have seen ICTs completely transform our lives, including the way politics and governance are played out. This started in Asia with the now famous 'coup de text' in the Philippines, followed by similar innovations in China, Korea, Malaysia, and Pakistan. More recently, in the United States (US), the Obama campaign demonstrated the importance of ICTs in creating awareness and motivating action. The 2005–2006 edition of DirAP sought to prepare the DirAP audience for this kind of phenomena. The edition included reference to disruptive ICTs, with a close-up examination of the social, political, and cultural aspects of e-governance and the need to provide appropriate ICTs using Open Source programs and local language tools. In the 2007–2008 edition, we featured developments in mobile and wireless technologies, as the remarkable growth of cell-phone technology and Web 2.0 tools are impacting on public socialization and conscientization. This prognostic element is central to our motivation in producing DirAP as a regular Asia-watch serial.

In addition to tracking the way ICTs are used for political change in Asia, DirAP keeps a close eye on the impact of ICTs on the education, health, and livelihood of communities in the region. For the 2009–2010 edition, we have selected education as a principal theme. We are focusing on the state of ICT deployment and innovation in basic education, non-formal education, distance education, capacity-building for education policymakers and practitioners, and public-private partnerships in ICT for education.

DirAP has evolved since its inception in small and big ways. It has increased in volume, with a growing network of writers from the Asia Pacific region. It has adopted a co-authoring style to reflect multiple voices — a methodological posture that has been constant since the creation of DirAP and that can be summarized as follows:

The voices of DirAP are independent and if they are ideological at all, they are the voices of these writers who are the key movers and shakers in the ICT for development arena in the region. We believe that this multiplicity of voices, which includes those of policymakers, professionals from the private sector and senior scholars, offers a unique opportunity to access the richness and the complexity of the debates, of the choices being made and to be made, and of the major issues in the interface between communication and development. And we strongly believe in the importance of this complementarity and diversity

of voices, ensuring that, as in Kurozawa's *Rashomon*, the perspectives of the different actors are represented but also debated through research and statistical evidence. (Ng and Charron 2007)

The last three editions of DirAP were launched at the United Nations World Summit on the Information Society in Geneva (2003) and Tunis (2005), and at the Global Knowledge Partnership GKIII Conference in Kuala Lumpur (2007). They reached both Asia Pacific and international stakeholders in ICT for development (ICTD). Chin Saik Yoon and Felix Librero expertly served as chief editors of these previous editions. This year, we are most grateful to Shahid Akhtar and Patricia Arinto for convening this diversity of voices. We thank DirAP's editors and the editorial board for helping to transform the ferment in the field into a rather unique series of studies over time.

DirAP has ventured outside the ICT arena to bring in other disciplines to explain the effects of ICT in their fields. DirAP will continue to evolve, perhaps toward more interactive, participatory electronic formats. Whatever changes we make for the future editions of DirAP, we hope that the publication remains a useful source of research in ICTD that allows for an unfolding view and narrative. We hope too that ICTD stakeholders in Asia Pacific see DirAP as an opportunity to publish about ICTD efforts in the region and to reflect on platforms that they consider important for influencing change. And we hope that other ICTD stakeholders around the world will learn from these testimonies and experiences of ICTD in Asia Pacific unfiltered by what Edward Said (1978) referred to as an Orientalist bias.

Kenichi Ohmae's (1990) metaphor of a 'Borderless World' and Thomas Friedman's (2005) concept of a 'Flat World' might sound a bit stale to some. But in the current global crisis, one could argue to the contrary — that they are absolutely right. Moreover, Servaes's (2000) view that strengthening the

educational sector through the use of technology is a necessary precondition to meeting the challenges of a global world seems to ring more true today than it did at the beginning of the millennium. As publishers, we are proud to share with readers these narratives from different voices in the field, each of them attempting from their own perspective to respond to the current and future imperatives of ICTD in a networked society that seems to have shifted to a new age from that foretold by Castells (1996).

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Introduction

The information age has been driven and dominated by technopreneurs — a small army of 'geeks' who have reshaped our world faster than any political leader has ever done.... We now have to apply these technologies for saving lives, improving livelihoods and lifting millions of people out of squalor, misery and suffering. In short, the time has come to move our focus from the geeks to the meek.

(Sir Arthur C. Clarke)

When Marshall McLuhan coined the term 'global village' in 1962, he was referring to the removal of space and time barriers in human communication as a result of the communication revolution taking place at the time. Today, we are living in a global village in every sense of the term. This has never been more evident than in the financial and economic crisis gripping the world today.

Banks are failing and stock markets are tumbling. The automotive, construction, insurance, manufacturing, tourism, and other industries are suffering their greatest losses in years. The prices of commodities like oil, copper, lead, nickel, platinum, and wheat have fallen 65–88 percent from their peaks. Households have lost billions in real estate and pension fund reserves are dwindling. Countless small and medium-sized companies are going bankrupt and millions of jobs are being lost. The Asian Development Bank estimates that more than USD 50 trillion in invested wealth vanished into thin air in 2008. The world is in a deflationary spiral.

Much of the crisis concerns the United States (US) and countries in the European Community. But given the interconnectedness of the world's financial and economic systems, economies around the world are experiencing a downturn. Even the biggest economies, like China, are hurting. Li Yizhong, head of China's Ministry of Information and Technology, has noted that 'the international financial crisis is having a severe domestic impact' and 'just about every industry has overcapacity'. Zhang Ping, head of China's planning body, predicts that '[e]xcessive bankruptcies and production cuts will bring massive unemployment, stirring social unrest. Owing to dramatic changes in the international economic and financial environment, the Chinese economy faces growing downside pressure'. And the head of the Australian central bank, Glenn Stevens, whose country is one of the key suppliers of natural resources to China, has said that '[t]he most striking real economic fact of the past several months is not continued U.S. economic weakness, but that China's economy has slowed much more quickly than anyone had forecast' (Sagami 2008).

It will take several years, maybe even a decade, before the recession (some call it 'depression') that the world is facing today can be fully turned around and all the losses made up. The next several years are not going to be easy for most developing countries and many that were already struggling to meet the Millennium Development Bank (MDGs) goals and targets are going to be facing even greater difficulties in realizing these goals. The new information and communication technologies (ICTs) have been a driving force of the globalized world in which we find ourselves today. Do ICTs have a role in helping to turn the global situation around?

Now more than ever, countries need more efficient, accountable and transparent government. And it is a well documented fact that use of ICTs assists in sharing information more effectively and delivering better services to the public. 'ICTs, wisely deployed, can potentially impact almost every sector, making development budgets, private sector investments and commitments from development partners go that much further in terms of cost effectiveness, impact and reach' (UNDP 2005, p. 1). ICTs help to increase transparency and accountability and decrease corruption. They promote economic growth by improving the interface with business and empowering citizens to participate in advancing good governance. ICTs also help to accelerate the pace of sustainable human development and to '... increase the effectiveness of new and more responsive solutions in the fields of health, education and related MDG focus areas' (UNDP 2005, p. 1).

The *Digital Review of Asia Pacific* (DirAP) aims to serve as a guide for ICT-related policy development, planning, research, and project implementation in the region. Like the previous editions, the 2009–2010 edition of DirAP reports on key ICT for development (ICTD) initiatives across the Asia Pacific region. The present edition of DirAP consists of four parts:

- Part A includes regional overviews on ICTD, regulatory approaches to ICT, and managing innovation.
- Part B, consisting of five chapters, focuses on various aspects of ICT in education.

- Part C assesses the ICT initiatives of four sub-regional groupings.
- Part D reviews the digital status of 30 economies.

The chapters in Part D report on the status of the technology infrastructure, ICT industries, digital content, online services, key ICT initiatives, enabling policies, regulatory environment, education and capacity-building programs, open source initiatives, ICT-related research and development, and ICTD trends and challenges up to mid-2008[1] in each of the 30 economies covered. The common framework that underpins these reports allows readers to undertake a comparative analysis and assess progress across the region.

The chapters in Parts A and C provide two types of comparative analyses of the ICT initiatives presented. In Part C, the comparative perspective is sub-regional, with four chapters reviewing the ICT initiatives of four political and economic groups. Budden, Jorari, and Taufao describe the digital status of the Pacific Island Countries. Garcia and Lallana provide an overview of the ICT initiatives of the Asia-Pacific Economic Cooperation (APEC). Lim outlines ICT-related aspects of the work of the Association of Southeast Asian Nations (ASEAN) toward building the ASEAN Community. Pradhan and Liyanage review recent initiatives by the South Asian Association for Regional Cooperation (SAARC) to foster regional collaboration in ICTD.

Part A provides regional perspectives. In 'ICT for development in Asia Pacific: Emerging themes in a diverse region', Butt and Sarker outline some key concepts that are useful for analyzing and evaluating ICTD initiatives in the region. In 'An overview of regulatory approaches to ICTs in Asia and thoughts on best practices for the future', Sreenivasan and Singh compare regulatory approaches in Asian jurisdictions, and describe what they consider to be the four pillars of ICT policy, namely, citizen-focused e-government services, improving access to education, open source software development, and localized and indigenous digital content development and regulation. In 'Managing innovation in the network economy: Lessons for countries in the Asia Pacific region', Nair and Shariffadeen consider the role of national innovation ecosystems in enhancing the innovative capacity and competitiveness of nations in the network economy. They propose a quantitative method of assessing national innovation capacity and outline strategies to close the digital and innovation divides between countries in Asia Pacific and other regions.

The chapters in Part B of this edition of DirAP revolve around the theme of ICTs and education. Strengthening the innovative capacity of countries and ensuring broad-based and equitable development require, among others, giving priority to education

for all citizens. Indeed, the second MDG is the achievement of universal primary education. Education is a basic human right, and it is a precondition of economic and social development. ICTs are increasingly recognized as an important means of providing education for all and building the capacity of individuals and communities to survive and thrive in the knowledge-based economy. The 2005 UNDP Regional Human Development Report notes that 'ICTs are already creating new possibilities for "reaching the unreached" and also for making lifelong education feasible for all' and that 'these trends would only gather momentum and could imply a revolution, provided determined efforts are made to promote appropriate use of ICTs as innovative new delivery mechanisms for system-wide provision of education' (UNDP 2005, p. 12).

In the chapter titled 'Education for all in the digital age', Dhanarajan describes the important role that the new digital technologies can play in the global movement toward Education for All (EFA) that was launched in 1990 at Jomtien, Thailand, and affirmed in 2000 through the Dakar Framework for Action. The chapter also outlines factors that policymakers must consider in harnessing ICTs to provide education for all. These include the need for policy recognizing different modes of education, including open and distance learning, and alternative learning.

Baggaley, Belawati, and Malik, in their chapter titled 'Distance education in Asia Pacific', provide an overview of trends in distance education in the region, including the use of mobile phones in learning. The chapter discusses issues affecting Asian distance education institutions, such as lack of access to e-learning technologies, and the need to develop a distinctively Asian approach to distance education.

ICT use in non-formal education programs for out-of-school youth and adults is the focus of 'ICTs in non-formal education in Asia Pacific' by Dighe, Hakeem, and Shaeffer. Arguing that non-formal education has an important role to play in achieving quality education for all sectors of society, especially marginalized groups that comprise a significant percentage of the population in developing countries, the chapter critically examines the progress made and the lessons learned in the use of ICTs in non-formal education in the Asia Pacific region.

In 'Capacity-building for ICT integration in education', Ng, Miao, and Lee focus on building the capacity of policymakers and educators in Asia Pacific countries to integrate ICT in education. The basic elements of a holistic ICT in education policy and an ICT in education toolkit for policymakers and planners are detailed, as well as the dimensions of integrated teacher professional development that would enable teachers to use ICT effectively and appropriately to support national education goals. A case is made for moving away from technocentric planning and implementation approaches to ICT integration, to models

that focus on establishing sound policy and support strategies leading to capacity development and empowerment.

The final chapter in the thematic section on ICT and education is on 'Public-private partnerships in ICT for education' by Pillay and Hearn. ICT-supported education requires large investments not only in equipment and infrastructure but also in human resource development. Public-private partnerships are described as a means for governments to meet increasing demands for ICT-supported education reform and expansion.

In describing and analyzing trends and issues in the use of ICT in key areas such as education and governance in the Asia Pacific region, this edition of DirAP hopes to give its readers greater insight into the application of ICTs for sustainable human development. ICTs have been instrumental in the realization of a globalized world. Globalization has brought greater interdependence, with both positive and negative effects on economies and societies. When used wisely, ICTs can help mitigate some of the negative impacts and maximize the positive outcomes of interdependence, through better coordination and monitoring of development efforts, building partnerships between the public and private sectors and between governments and citizens, and fostering the innovative capacity and entrepreneurial spirit of individuals and communities.

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Shahid Akhtar and **Patricia Arinto**
Editors, *Digital Review of Asia Pacific 2009–2010*

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NOTE

1. As is normally the case with analytical reviews, there is a time lag between when such reviews are actually written and their formal publication. The chapters on the individual economies reflect conditions at the time of writing, which was essentially around early to mid-2008, prior to the global economic and financial crisis beginning in late 2008.

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Acronyms

2G	second generation mobile phone standards and technology
3G	third generation mobile phone standards and technology
A&E	Accreditation and Equivalency
AAOU	Asian Association of Open Universities
ABAC	APEC Business Advisory Council
ABS	Australian Bureau of Statistics
ABS–CBN	Alto Broadcasting System-Chronicle Broadcasting Network
ACBT	Australian College of Business and Technology
ACC	ASEAN Coordinating Council
ACEN	APEC Cyber Education Network
ACMA	Australian Communications and Media Authority
ACS	Australian Computer Society
ACSA	Afghan Computer Science Association
ACTOS	Association of Computer Training Organizations
ADB	Asian Development Bank
ADSL	Asymmetric Digital Subscriber Line
AEC	ASEAN Economic Community
AEEMA	Australian Electrical and Electronic Manufacturers' Association
AGC	Attorney-General's Chambers
AGIMO	Australian Government Information Management Office
AHAN	Aik Hunar Aik Nagar (One Village One Product)
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AIG	Australian Industry Group
AIIA	Australian Information Industry Association
AIL	Afghan Institute of Learning
AIMS	Afghanistan Information Management Services
AIOU	Allama Iqbal Open University
AiTi	Authority for Info-communications Technology Industry
AKAKOM	Akademi Komputer or East Timor Computer Academy
ALP	Australian Labor Party
ALU	Alcatel-Lucent
ALS	Alternative Learning System
AMCAM	American Cambodian Business Council
AMN	Afghan Media International
ANDC	Afghanistan National Data Centre
ANDS	Afghanistan National Development Strategy
ANZ	Australia New Zealand Bank
AOTS	Association for Overseas Technical Scholarships
APEC	Asia-Pacific Economic Cooperation
APEC TEL	Asia-Pacific Economic Cooperation Telecommunications and Information Working Group
APIAN	APEC International Assessment Network
APIIT	Asia Pacific Institute for Information Technology
APJII	Asosiasi Penyelenggara Jasa Internet Indonesia (Indonesian Internet Service Providers Association)
APKOMINDO	Asosiasi Perusahaan Komputer Indonesia (Indonesian Computer Business Association)
APNIC	Asia-Pacific Network Information Centre
APPEAL	Asia Pacific Programme of Education for All
APT	Asia Pacific Telecommunity
ARC	Administrative Reforms Committee
ARCOM	Autoridade Reguladora das Communicações or Communications Regulatory Authority
ARPU	Average revenue per user
ARTC	APPEAL Resource and Training Consortium
ASC	ASEAN Security Community
ASCC	ASEAN Socio-Cultural Community
ASEAN	Association of Southeast Asian Nations
ASEC	ASEAN Secretariat
ASED	ASEAN Education Ministers Meeting
ASFI	Advanced Software Foundation Inc
ASP	Application Service Provider
ASSI	Asosiasi Satelit Indonesia (Indonesian Satellite Association)
AST	ASEAN Science and Technology

ASTI	Advanced Science and Technology Institute	BTCL	Bangladesh Telecommunications Company Limited
ATM	Automatic teller machine	BTN	Bhutanese ngultrum (currency)
ATRA	Afghanistan Telecom Regulatory Authority	BTRC	Bangladesh Telecommunications Regulatory Commission
ATRC	ASEAN Telecommunications Regulators Council	BTS	Base Transceiver Station
AUAF	American University of Afghanistan	BTTB	Bangladesh Telegraph and Telephone Board
AWARI	Asosiasi Warnet Indonesia (Indonesian Internet Kiosk Association)	CA	Certification Authority
		CAGR	Compound Annual Growth Rate
AWCC	Afghan Wireless Communication Company	CAL	Computer-aided Learning
		CAN	Computer Association of Nepal
BA	Bachelor of Arts	CASIA	Chinese Academy of Sciences, Institute of Automation
BASIS	Bangladesh Association of Software and Information Services	CAT	Communications Authority of Thailand
BayanDSL	BayanTel Digital Subscribe Line	CATV	Community Antenna Television, now known as Cable Television
BayanTel	Bayan Telecommunication	CBN	Capacity Building Network
BBS	Bangladesh Bureau of Statistics	CBO	Community-based organization
BCCP	Bangladesh Centre for Communication Programs	CC	Creative Commons
		CCC	Ceylon Chamber of Commerce
BcN	Broadband Convergence Network	CCRTVU	China Central Radio and TV University
BdOSN	Bangladesh Open Source Network	CCT	Science and Technology Committee
BDT	Bangladeshi taka (currency)	CD	Compact disc
BEDB	Brunei Economic Development Board	CDAC	Centre for Development of Advanced Computing
BFAD	Bureau of Food and Drugs		
BHMPS	Bhutan HRD Master Plan and Strategies	CDMA	Code Division Multiple Access
BHUs	Basic health units	CD-ROM	Compact Disc-Read Only Memory
BICMA	Bhutan InfoComm and Media Authority	CeC	Community e-Centre
BIPS	Bhutan ICT Policy and Strategy	CEDFIT	Cebu Educational Foundation for Information Technology
BIR	Bureau of Internal Revenue		
BIT	Bachelor of Information Technology	CEO	Chief Executive Officer
BMC	Budget and Management Committee	CEPAS	Specification for Contactless e-Purse Application
BND	Brunei dollar		
BNU	Banco Nacional Ultramarino	CERTs	Computer Emergency Response Teams
BoC	Bureau of Customs	CET	Connect East Timor
BOI	Board of Investment	CETC	SPC Community Education Training Centre, Fiji
BOT	Bank of Thailand		
BPAP	Business Processing Association of the Philippines	CGIAR	Consulative Group on International Agricultural Research
BPO	Business Process Outsourcing		
BPPT	Badan Pengkajian dan Penerapan Teknologi (Agency for the Assessment and Application of Technology)	CHA	Consortium of Humanitarian Agencies
		CHED	Commission on Higher Education
		CIA	Central Intelligence Agency (US)
BRAC	Bangladesh Rural Advancement Committee	CIC	Community Information Centre
BRTI	Badan Regulasi Telekomunikasi Indonesia (Indonesia Telecommunication Regulatory Body)	CICC	Center of the International Cooperation on Computerization
		CICT	Commission on Information and Communications Technology
BSA	Business Software Alliance		
BSNL	Bharat Sanchar Nigam Ltd	CID	Harvard Centre for International Development Model
BT	Bhutan Telecom Ltd		

CIDA	Canadian International Development Agency	DCITA	Department of Communication, Information Technology and the Arts
CII	Confederation of Indian Industry	DCSF	Diliman Computer Science Foundation
CIMA	Chartered Institute of Management Accountants	DDC	Dzongkha Development Commission
		DDD	Digital Divide Data
CIO	Chief Information Officer	DE	Distance education
CIT	Communications and Information Technology	DEEWR	Department for Education, Employment and Workplace Relations
CITREP	Critical Infocomm Technology Resource Programme	DEF	Digital Empowerment Foundation
		DEMP	Distance Education Modernization Project
CLC	Community Learning Centre	Depbudpar	Departemen Kebudayaan dan Pariwisata (Department of Culture and Tourism)
CMA	Computer Misuse Act		
CMC	Community Multimedia Centres	Depdiknas	Departemen Pendidikan Nasional (National Education Department)
CMMI	Capability Maturity Model Integration		
CMOS	Complementary Metal Oxide Semiconductor	DepEd	Department of Education
CMS	Clinic Management System	DEST	Department for Education, Science and Training
CMTS	Cellular Mobile Telephone Service		
CNMI	Commonwealth of the Northern Marianas	DETIKNAS	Dewan TIK Nasional (National ICT Council)
CNNIC	China Internet Network Information Center		
COO	Chief Operating Officer	DFAT	Department of Foreign Affairs and Trade
CoP	Communities of Practice	DICT	Department of Information and Communication Technology
CP	Certificate Policy		
CPE	Customer Premises Equipment	Digitel	Digital Telecommunications Phils. Inc.
CPP	Calling Party Pays	DIMS	Diploma in Information Management System
CPS	Certificate Practice Statement	Dirjen Postel	Direktorat Jenderal Pos dan Telekomunikasi (Directorate General of Post and Telecommunication)
CPTTM	Macau Productivity and Technology Transfer Center		
		DIT	Department of Information Technology
CRAT	Cyber Regulatory Appellate Tribunal	DLTV	Distance Learning Television
CRC	Communications Regulatory Commission	DMB	Digital Multimedia Broadcasting
CRO	Communications Regulatory Organization	DNA	Deoxyribonucleic acid
CROP	Council of Regional Organizations of the Pacific	DNOP	Data Network Operators Pakistan
		DOEACC	Department of Electronics and Accreditation of Computer Courses
CRULP	Centre for Research in Urdu Language Processing		
		DOI	Digital Opportunities Initiative
CSAT	College Scholastic Ability Test	DOH	Department of Health
CSL	Computer Services Ltd, Samoa	DoS	Denial-of-Service
CSMS	Computer Science and Management School	DOST	Department of Science and Technology
CSSL	Computer Society of Sri Lanka	DOTC	Department of Transportation and Communications
CTI	Committee on Trade and Investment		
CTM	Companhia de Telecomunicações de Macau (Macau Telecommunications Company)	DPI	Data Processing Iran Company (ex-IBM branch in Iran)
CTT	Direcção dos Serviços de Correios, Telefonicos e Tegraphicos de Macau (Telephony and Telegraphy Bureau)	DPR	Dewan Perwakilan Rakyat (House of Representatives)
		DRM	Digital Rights Management
DAISY	Digital Accessible Information System	DRMASS	Digital Multiple Access Subscriber System
DANIDA	Danish International Development Agency	DSEJ	Direcção dos Serviços de Educação e Juventude (Education and Youth Affairs Bureau)
DBCDE	Department of Broadband, Communications and the Digital Economy		
DCI	Data Communications Company		

DSGs	Deputy Secretary-Generals
DSL	Digital Subscriber Line
DSRT	Direcção dos Serviços de Regulação de Telecomunicações (Bureau of Telecommunications Regulation)
DSWD	Department of Social Welfare and Development
DTAS	Diagnostics Tutorial Assessment System
DTI	Department of Trade and Industry
DTIS	Diagnostic Trade Integration Studies
DTT	Digital Terrestrial Television
DTV	Digital television
DVB	Digital Video Broadcast
DVD	Digital versatile disc
DWDM	Dense Wavelength Division Multiplexing
E3	Philippines' Electronic Governance for Efficiency and Effectiveness
EBS	Educational Broadcasting System
EC	Economic Committee
ECA	Electronic Commerce Act
ECER	East Coast Economic Region
ECSG	Electronic Commerce Steering Group
ECTI	Electronic Computer Telecommunication and Information
ECVN	e-Commerce Vietnam
EDB	Economic Development Board
EDGE	Enhanced Data Rate for GSM Evolution
eDLTV	eLearning Based on Distance Learning Television
EDMS	Electronic Document Management System
EDNET	APEC Education Network
EDS	Electronic Documents and Signatures
EDXL	Emergency Data Exchange Language
EECV	Emergency and Education Vehicle
EFA	Education for All
EFT	Electronic Funds Transfer
EGD	e-Government Directorate
EGTAB	e-Government Technical Advisory Body
EGTL	e-Government Leadership Forum
EHR	Electronic Health Records
ELK	Enabling Language Kit
EMIS	Education Management Information Systems
e-NTF	e-National Task Force
ESCAP	Economic and Social Commission for Asia and the Pacific
ESFRD	Electronics Support Fund for Research and Development

ETPI	Eastern Telecommunications Philippines Inc.
EU	European Union
EUP	Eco-Design of Energy-using Products
EVN	Electricity of Vietnam
FDCT	Science and Technology Development Fund
FDI	Foreign Direct Investment
FE	Fundamentals of IT Engineer
FECS	Fundamentals of IT Engineer Certification Standards
FedGIS	Federated Geospatial Information System
FERI	Foundation of Education Research and Education
FFA	Pacific Islands Forum Fisheries Agency
F-FDTL	Falintil-Forcas Defesa de Timor-Leste or Timor-Leste Defense Force
FITIS	Federation of IT Industry in Sri Lanka
FLEMMS	Functional Literacy, Education, and Mass Media Survey
FLOSSWorld	Free/Libre/Open Sources Software (FLOSS) World
FMAC	Macau Foundation
FMC	Fixed Mobile Convergence
FMIC	French Medical Institute for Children
FNRI	Food and Nutrition Research Institute
FOSS	Free and Open Source Software
FPCCI	Federation of Pakistan Chambers of Commerce and Industry
FRST	Foundation for Research, Science, and Technology
FSM	Federated States of Micronesia
FTA	Free-to-Air
FTI	Fast Track Initiative
FTII	Federasi Teknologi Informasi Indonesia (Indonesia Information Technology Federation)
FTTH	Fibre-to-the-Home
FTTN	Fibre-to-the-Node
FUP	Fundação das Universidades Portuguesas
FWA	Fixed Wireless Access
G2B	Government-to-Business
G2C	Government-to-Citizen
G2G	Government-to-Government
G4C	Government-for-Citizens
GATS	General Agreement on Trade in Services
Gb	Gigabyte
Gbps	Gigabits per second
GCA	Government Certification Authority
GCC	Government Computer College

GCIO	Government Chief Information Officer
GCS	Global Care Solutions Company Limited
GDDS	General Data Dissemination System
GDLN	World Bank's Global Distance Learning Network
GDOI	Global Digital Opportunity Initiative
GDP	Gross Domestic Product
GDTTI	Gabinete para o Desenvolvimento das Telecomunicações e Tecnologias da Informação (Office for the Development of Telecommunications and Information Technology)
GeSCI	Global e-Schools and Communities Initiatives
GIC	Government Information Centre
GILAS	Gearing Up Internet Literacy and Access for Students
GIS	Geographical Information System
GLOCOM	Japan's Center for Global Communications
GNH	Gross National Happiness
GNP	Gross National Product
GNU Linux	GNU's Not Unix Linux
GoM	Government of Mongolia
GoP	Government of Pakistan
GOSL	Government of Sri Lanka
GPDP	Office for Personal Data Protection
GPMS	Government Personnel Management System
GPRS	General Packet Radio Service
GPS	Global Positioning Systems
GRP	Government of the Republic of the Philippines
GS	Grama Sevaka (village headman)
GSIS	Government Service Insurance System
GSM	Global System for Mobile Communication
GTZ	Deutche Gesellschaft fur Technische Zussammenardeit — German Technical Cooperation
GXA	Games Exchange Alliance
HCA	Ho Chi Minh City Computer Association
HCCR	High Council of Cultural Revolution
HCDG	Human Capital Development Group
HCI	High Council of Informatics
HCID	High Council of Information Dissemination
HDD	Hard Disc Drive
HDDI	Hard Disc Drive Institution
HDIA	Human Impact Development Assessment of Trade
HDSL	High bit-rate Digital Subscriber Line
HDTV	High Definition Television

HEIs	Higher Education Institutions
HFC	Hybrid Fibre-Coaxial
HIES	Household Income and Expenditure Survey
HIV	Human Immunodeficiency Virus, the cause of AIDS (Acquired Immunodeficiency Syndrome)
HLCIT	High Level Commission on IT
HRD	Human Resource Development
HRDWG	Human Resource Development Working Group
HRM	Human Resource Management
HSBC	Hong Kong and Shanghai Banking Corporation
HSDPA	High Speed Downlink Packet Access
HSPA	High Speed Packet Access
IA	Infocomm Accessibility
IAC-ICTS	Interagency Committee on Information and Communication Technology Statistics
IAEA	International Atomic Energy Agency
IAMAI	Internet and Mobile Association of India
IAS	International Accounting Standards
IC	Integrated Circuits
ICAM	Intelligent Content Assessment Marking
ICANN	Internet Corporation for Assigned Names and Numbers
ICDL	International Computer Driving Licence
ICI	Interconnection Institute
ICIMOD	Nepal's International Centre for Integrated Mountain Development
ICM	Information, Communication, and Media
ICMA	Information, Communication, and Media Act
ICP	Internet Connection Provider
ICT	Information and Communication Technology
ICTA	Information and Communication Technology Authority
ICT4D/ICTD	Information and Communication Technology for Development
ICT-TL	Timor-Leste ICT Association
ICTWG	ICT Working Group
ICX	Interconnection Exchange
ID	Identity/Identification
IDA	Info-Communications Development Authority of Singapore
IDC	International Data Corporation
ID-INC	Indonesia-Network Information
IDM	Interactive Digital Media

IDN	International Domain Name	ISDN	Integrated Service Data Network
IDR	Iskandar Development Region	iSLRCs	i-Schools Learning Resource Centers
IDRC	International Development Research Centre	ISOC	Internet Society
IDRCC	International Development Research Centre of Canada	ISP	Internet service provider
		ISPAK	Internet Service Providers of Pakistan
ID-SIRTII	Indonesia Security Incident Response Team on Internet Infrastructure	ISPAN	Internet Service Providers Association of Nepal
IDTUG	Indonesia Telecommunication Users Group	ISPANZ	Internet Service Providers Association of New Zealand
IEAA	Interactive Entertainment Association of Australia	IT	Information Technology
		ITC	Information Technology Company
IFRS	International Financial Reporting Standard	ITEC	Indian Technical and Economic Co-operation
IG	International Gateway		
IGNOU	Indira Gandhi National Open University	ITES	IT enabled Services
IGOS	Indonesia Goes Open Source	ITFP	Information Technology Foundation of the Philippines
IIREM	Innovating ICT for Rural Education of Mongolia	ITH	Income Tax Holidays
IIT	Informatics Institute of Technology	ITMX	Interbank Transaction Management and Exchange
IITA	Institute for Information Technology Advancement	ITRC	Iran Telecommunications Research Center
IITC	International IT Conference	ITS	Intelligent Transport System
IIUM	Macau Inter-University Institute	ITU	International Telecommunication Union
IKC	IlmuKomputer.com	IX	Internet Exchanges
ILDTSP	International Long Distance Telecommunication Services Policy	J2ME	Java 2 Micro Edition
		JARDIKNAS	Jaringan Pendidikan Nasional (National Education Network)
ILO	International Labour Organisation		
IMF	International Monetary Fund	JEDI	Java Education and Development Initiative
IMS	Interactive Multimedia Subsystem	JETRO	Japan External Trade Organization
INESC	Institute of Engineering Systems and Computers	JETS	Japanese-European Technology Studies Institute
Info Timor	Info Exchange East Timor	JICA	Japan International Cooperation Agency
iNSPIRE	iNfocomm Spark an Inspiring and Rewarding Experience	JITEC	Japan Information Technology Engineers Examination Center
IOB	East Timor Institute of Business	KADO	Korea Agency for Digital Opportunity and Promotion
IP	Internet Protocol		
IPA	Ingrated Programme of Action	Kbps	Kilobits per second
IPC	Informatization Promotion Committee	KC	Knowledge Channel
IPM	Institute for Studies in Theoretical Physics and Mathematics	KCC	Korea Communications Commission
		KCF	Knowledge Channel Foundation
IPR	Intellectual Property Rights	KCS	Korea Customs Service
IPRA	Intellectual Property Rights Act	KEPCO	Korea Electric Power Corporation
IPTV	Internet Protocol Television	KIPA	Korean International Promotion Agency
IPv4	Internet Protocol version 4	KISDI	Korea Information Society Development Institute
IPv6	Internet Protocol version 6		
IRCTC	Indian Railway Catering and Tourism Corporation Limited	KMPCD	Kathmandu Metropolitan Police Crime Division
IRQUE	Improving the Relevance and Quality of Undergraduate Education	KOICA	Korea International Cooperation Agency
		KPO	Knowledge Process Outsourcing
IRTI Act	Right to Information Act (India)	KREN	Korean Education Network

KRW	Korean won (currency)
KSFC	Korea Software Financial Cooperative
KT	Korea Telecom
LAMP/WAMP	Linux, Apache, Mysql, and Php/Link Access Procedure for Modems/Windows, Apache, Mysql, and Php
LANIC	Lao National Internet Committee
LCD	Liquid Crystal Display
LDCs	Least Developed Countries
LDI	Long Distance and International Services
LEARN	Lanka Education and Research Network
LED	Light Emitting Diode Lamp
LETAS	Local Enterprise Technical Assistance Scheme
LGN	Lanka Government Network
LGU	Local government unit
LIFE	Literacy Initiative for Empowerment
LINX	London Internet Exchange
LIPI	Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Science)
LKLUG	Lanka Linux User Group
LL	Local Loop
LMS	Learning Management System
LRC	Labour Recruitment Committee
LRT	Likelihood Ratio Test
LSF	Lanka Software Foundation
LSPN	Labour and Social Protection Network
LTO	Land Transportation Office
LUGS	Linux User Group of Singapore
M&As	Mergers and Acquisitions
MA	Master of Arts
MAMPU	Malaysian Administrative Modernization and Management Planning Unit
MAP	Management Association of the Philippines
MASTEL	Masyarakat Telematika
MB	Megabit
MBA	Master of Business Administration
Mbps	Megabits per second
MCEA	Myanmar Computer Enthusiasts Association
MCF	Myanmar Computer Federation
MCH	Ministry for Culture and Heritage
MCHE	Maldives College of Higher Education
MCIA	Myanmar Computer Industry Association
MCIT	Ministry of Communications and IT
MCMC	Malaysian Communications and Multimedia Commission
MCPA	Myanmar Computer Professionals Association
MCSDC	Myanmar Computer Science Development Council

MCTV	Macau Cable TV
MDA	Media Development Authority of Singapore
MDec	Multimedia Development Corporation
MDGs	Millennium Development Goals
MDIRD	Macau Document Information Resource Database
MECS	Ministry of Education, Culture and Science
MED	Ministry of Economic Development
METI	Ministry of Economy, Trade and Industry
MGP	Macau Grand Prix
MGTO	Macau Government Tourist Office
MIB	Maldives Internet Banking
MIC	Ministry of Internal Affairs and Communication
MICA	Ministry of Information, Communications and the Arts
MICT	Ministry of Information and Communication Technology
MIMOS	Malaysian Institute of Microelectronic Systems
MISPA	Mongolian Internet Service Providers Association
MIT	Massachusetts Institute of Technology
MKE	Ministry of Knowledge Economy
MMP	Macau Memory Project
MMS	Multimedia Messaging System
MNP	Mobile Number Portability
MoC	Ministry of Commerce
MOCIE	Ministry of Commerce, Industry, and Energy
MoE	Ministry of Education
MOECS	Ministry of Education, Culture, and Science
MOET	Ministry of Education and Training
MoEYS	Ministry of Education, Youth, and Sport
MoF	Ministry of Finance
MOGAHA	Ministry of Government Administration and Home Affairs
MOH	Ministry of Health
MoIC	Ministry of Information and Communication
MOIT	Ministry of Industry and Trade
MoITT	Ministry of IT and Telecommunications
MOPAS	Ministry of Public Administration and Security
MOSA	Mongolian Software Industry Association
MOST	Ministry of Science and Technology
MOU	Memorandum of Understanding
MOWD	Ministry of Women's Development
MPDF	Mekong Private Sector Development Facility

MPEG	Moving Picture Expert Group
MPLS	Multi-Protocol Label Switching
MPO	Management and Budget Organization (formerly PBO)
MPT	Myanmar Posts and Telecommunications
MPTC	Ministry of Posts Telegraph and Communications
MPTT	Ministry of Post, Telegraph, and Telephone
MRA	Mutual Recognition Agreement for Conformity Assessment of Telecommunications Equipment
MS	Microsoft
MSAR	Macau Special Administrative Region
MSC	Multimedia Super Corridor
MSN	Microsoft Network
MSUE	Mongolian State University of Education
MTNL	Mahanagar Telephone Nigam Ltd
MTVS	Mobile Television Services
MUST	Mongolian University of Science and Technology
MVNO	Mobile virtual network operator
MyICMS 886	Malaysian Information, Communications and Multimedia Services 886
NADRA	National Database and Registration Authority
NARC	National Administrative Reforms Council
NASSCOM	National Association of Software and Services Companies
NAST	National Authority for Science and Technology
NBIS	National Basic Information System
NBN	National Broadband Network
NBTC	National Broadcasting and Telecommunications Commission
NCC	National Computer Center (Philippines)
NCER	Northern Corridor Economic Region
NCIT	National Centre for Information Technology
NCLHCR	National Centre for Linguistic and Cultural Research
NCSKSC	National Committee for the Standardization of Khmer Script in Computers
NCSTP	National Council for Science and Technology Policy
NDA	Non-Disclosure Agreements
NDAP	National Digital Archives Program
NDCC	National Disaster Coordinating Council
NDP	National Development Plan
NeGP	National e-Governance Plan

NECTEC	National Electronics and Computer Technology Center
NEDP	National Education Database Project
Nepse	Nepal Stock Exchange
NFE	Non-Formal Education
NGAs	National Government Agencies
NGN	Next Generation Network
NGNII	Next Generation National Information Infrastructure
NGO	Non-government organization
NGPP	National Grid Pilot Platform
NHRD	New Century Human Resource Development
NIA	National Information Society Agency
NIBM	National Institute of Business Management
NICF	National Infocomm Competency Framework
NICI	National Information and Communications Initiative Committee
NICT	National Institute of Information and Communications Technology
NICTAA	National ICT Alliance of Afghanistan
NICTCA	National ICT Council of Afghanistan
NiDA	National ITC Development Authority
NIE	National innovation ecosystem
NII	National Information Infrastructure
NIN	National Identity Number
NIOS	National Institute of Open Schooling
NIPO	National Intellectual Property Office
NIR	Network Information Resources
NIS	National Innovation Summit
NISC	National Information Security Center
NISER	National ICT Security and Emergency Response Centre
NISPAA	National ISP Association of Afghanistan
NITA	National Information Technology Agenda
NITC	National Information Technology Council
NITP	National Information Technology Park
NISTPASS	National Institute for Science and Technology Policy and Strategy Studies
NIXI	National Internet Exchange of India
NLP	Natural Language Processing
NMRIA	National Mapping and Resource Information Authority
NPTA	National Post and Telecom Authority
NPTEL	National Project on Technology Enhanced Learning
NREN	National Research and Education Network
NSA	Non-State Actors

NSB	National Statistical Bureau
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
NSTDA	National Science and Technology Development Agency
NSW	National Single Window
NT	Nepal Telecom
NTA	Nepal Telecom Authority
NTC	National Telecommunications Commission
NTT	Nippon Telegraph and Telephone
NTU	Nanyang Technological University
NUM	National University of Mongolia
NUOL	National University of Laos
NUS	National University of Singapore
NZ	New Zealand
NZD	New Zealand dollar
O&O	Outsourcing and Offshoring
OAK	Open Access to Knowledge
OCEI	Open Content in Education Initiative
OCR	Optical Character Recognition
ODA	Official Development Assistance
ODF	Open Document Format
ODL	Open and distance learning
ODLAA	Open and Distance Learning Association of Australia
OECD	Organisation for Economic Co-operation and Development
OFDMA	Orthogonal Frequency Division Multiplex Access
OFLC	Office of Film and Literature Classification
OIC	Organisation of the Islamic Conference
OLE-Nepal	Open Learning Exchange-Nepal
OLPC	One Laptop per Child
OpenCARE	Open exchange for Collaborative Activities in Response to Emergency
OPGW	Optical Power Ground Wire
OS	Operating system
OSCC	Open Source Competency Center
OSS	Open Source Software
OSSF	Open Source Software Foundry
OTBIP	Open Technology Business Incubation Program
OUHK	Open University of Hong Kong
P&G	Procter & Gamble
PIII	Pentium 3
P2P	Peer-to-Peer
PAC	Public Access Centre
PACCS	Pakistan Automated Commercial Community System
PaCCS	Pakistan Customs Computerized System

PACINET	Annual Technical Conference, and Annual General Meeting of PICISOC
PacNOG	Pacific Network Operators Group
PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration
PAIM	Plan of Action on Information and Media
PAN	Pan Asia Networking
PANDI	Pengelola Nama Domain Indonesia (Indonesia Domain Name Registry)
PANdora	PAN Asia Networking Distance and Open Resource Access
PANGTEL	Papua New Guinea Authority Telecommunications
PAP	Public Access Provider
PAQTVET II	Philippine-Australia Quality Technical Vocational Education and Training Project
PASHA	Pakistan All Software Houses Association
PAT 2004	Plan of Action on Telecommunications 2004
PBO	Plan and Budget Organization
PC	Personal computer
PCASTRD	Philippine Council for Advanced Science and Technology R&D
PCC	Proteur-created content
PCT	Portuguese/Chinese bi-directional Translation System
PCCW	Pacific Century Cyber Works
PDAs	Personal/Portable digital assistants
PDF	Portable Document Format
PDH	Plesiochronous Digital Hierarchy
PECC	Pacific Economic Cooperation Council
PEDC	Philippine Export Development Council
PEZA	Philippine Economic Zone Authority
PFIF	People Finder Interchange Format
PhilNITS	Philippine National Information Technology Standards
PHP	Philippine peso
PHS	Personal Handy-phone System
PIC	Pacific Island countries
PICISOC	Pacific Islands Chapter of the Internet Society
PICWIN	PAGASA Interactive Climate and Weather Information Network
PIFS	Pacific Islands Forum Secretariat
PiL	Partners-in-Learning Initiative
Piltel	Pilipino Telephone Corporation
PISA	Programme for International Student Assessment
PITA	Pacific Islands Telecommunication Association

PKI	Public key infrastructure	RSS	Really Simple Syndication
PLDT	Philippine Long Distance Telephone Company	RTCs	Rural Telecentres
		RTGS	Real-time interbank gross settlement system
PLUG	Philippine Linux Users Group	RTI	Right to Information
PMIS	Personnel Management Information System	RTM	Department of Technology (Malaysia)
PMO	Prime Minister's Office	RTOB	Real Time Online Branches
PMS	Presidential Management Staff	RTTC	Regional Teacher Training Centre
PMTDP	Philippine Medium-Term Development Plan	SAARC	South Asian Association for Regional Cooperation
PNG	Papua New Guinea		
POS	Point of sale	SaaS	Software as a Service
POSS	Philippine Open Source Summit	SAFMA	South Asia Free Media Association
POSX	Pampanga Open Source eXchange	SAFP	Direcção dos Serviços de Administração e Função Pública (Public Administration and Civil Service Bureau)
PPP	Public-private partnerships		
PRs	Permanent Representatives		
PSA	Panos South Asia	SAIC	SAARC Agricultural Information Centre
PSEB	Pakistan Software Export Board	SAP	Satellite Service Provider (Satellite Access Provider in Persian)
PSTN	Public Switched Telephone Network		
PTA	Pakistan Telecommunication Authority	SARS	Severe Acute Respiratory Syndrome
PTCL	Pakistan Telecommunications Company Ltd	SASEC	South Asia Subregional Economic Cooperation
PTI	Portuguese Telecom International		
PTTC	Provincial Teacher Training College	SAVE	SAARC Audio-Visual Exchange
PUST	Pyongyang University of Science and Technology	SBS	Special Broadcasting Services
		SCA	Spam Control Act
QGIS	Quantum Geographic Information System	SCCP	Sub-Committee on Customs Procedures
QUEST	Quality Education and Skills Training Alliance	SCIT	Supreme Council of IT
		SCORE	Sarawak Corridor of Renewable Energy
R&D	Research and development	SCORM	Shareable, Content Object Reference Model
RA	Registration Authority	SCPC	Single Channel Per Carrier
RAB	Rapid Action Battalion	SCZMC	SAARC Coastal Zone Management Centre
RAM	Random Access Memory	SDC	SAARC Documentation Centre
RDTL	República Democrática de Timor-Leste, the official name of Timor-Leste	SDH	Synchronous Data Hierarchy
		SDMC	SAARC Disaster Management Centre
READ	Rural Education and Development	SDSL	Symmetric Digital Subscriber Line
RFID	Radio-frequency identification	SEA	Software Exporters Association
RFP	Request for Proposal	SEAMEO	Southeast Asian Ministers of Education Organization
RGoB	Royal Government of Bhutan		
RIC	Rural Internet Centre	SEA–ME–WE	South East Asia–Middle East–Western Europe Cable System
RICE	Regional IT Centers of Excellence		
RICS	Pacific Islands Rural Internet Connectivity System	SEAMOLEC	Southeast Asian Ministers of Education Organization Regional Open Learning Centre
RIS	Regional Innovation Systems		
RISC	Reduced Instruction Set Computer	SEC	SAARC Energy Centre
Ristek	Riset dan Teknologi (Research and Technology)	SEI	Software Engineering Institute
		SEMP	Secondary Education Modernization Project
RLIC	Regional Learning and Innovation Culture		
RMC	SPC Regional Media Centre, Fiji	SEWA	Self-employed Women's Association
RMI	Republic of the Marshall Islands	SG	Secretary-General
R-NGN	Rural NGN	SGD	Singapore dollar
ROI	Return on investment	SGI	Sentral Gerbang Internasional (International Central Gate)
RPC	Revised Penal Code		

SGNIC	Singapore Network Information Centre	SOSA	Singapore Open Source Alliance
SHCI	Secretariat of HCI	SOX	Sarbanes-Oxley
SHRDC	SAARC Human Resource Development Centre	SPC	Secretariat of the Pacific Community
SIC	SAARC Information Centre	SPIDER	Swedish Program for ICT in Developing Regions
SIDA	Swedish International Development Cooperation Agency	SPIN	South Pacific Islands Network
SIGS	Security in the Government Sector	SPNL	Spice Nepal Private Limited
SIJs	Silver Infocomm Junctions	SPREP	Secretariat of the Pacific Regional Environment Programme
SIM	Subscriber Identity Module	SPT	Saigon Postel Telecommunication Company, Vietnam
SIN	Single Identity Number		
SINGAP-TL	Sistema Integrado para a Nova Gestão da Administração Pública de Timor-Leste or Integrated System for a New Management of East Timor's Public Administration	SQL	Structured Query Language
		SSME	Service Science, Management, and Engineering
		SSO	Shared Services and Outsourcing
SingPass	Singapore Personal Access	STAG	Science and Technology Advisory Group
SingStat	Statistics Singapore	STC	SAARC Tuberculosis Centre
SingTel	Singapore Telecommunications Limited	STI	Skill, Technology and Innovation
SIPA	Software Industry Promotion Agency	STL	Suara Timor Lorosae or the Voice of Timor-Leste
SIT	School of Information Technology		
SiTF	Singapore Infocomm Technology Federation	STM	synchronous transport module
SIRC	SMIE Infocomm Resource Centre	S/W	Software
SJI	Silver Infocomm Junction	SWCS	Software Design and Development Certification Standards
SKS	Sustainable Knowledge Systems		
SLASI	Sri Lanka Association for the Software Industry	TAE	Trans Asia Europe
		TAFE	Technical and Further Education
SLCERT	Sri Lanka Computer Emergency Response Team	TAKFA	Development of Information Technology Applications
SLCVA	Sri Lanka Computer Vendors Association	TAM	Telecommunications Authority of Maldives
SLI	Sambungan Langsung Internasional (International Direct-Calls)	TASMA	Production and Management of Electronic Content
SLICTA	Sri Lanka ICT Association	TAVANIR	Iran Power Generation, Transmission, and Distribution Company
SLT	Sri Lanka Telecom		
SMCS	School of Mathematics and Computer Science	TCF	Telecommunications Carriers' Forum
		TCI	Telecommunications Company of Iran
SME	Small and medium/medium-sized enterprises	TCO	Total Cost of Ownership
		TCPI	Telecommunications Consumer Protection Institute
SMEDA	Small and Medium Enterprise Development Authority	TDCA	Telecom Development Company of Afghanistan
SMP	Significant Market Power		
SMRC	SAARC Meterological Research Centre	TDF	Telecom Development Fund
SMS	Short Message Service	TDM	Teledifusão de Macau S.A. (Macao TV Broadcasting Co.)
SNPL	Spice Nepal		
SNS	Social Networking Service	TDSCDMA	Time Division-synchronous Code Division Multiple Access
SoC	System on Chip		
SOE	Standard ICT Operating Environment	TELMIN	Telecommunications and IT Ministers Meeting
SOM	Senior Officials' Meeting	TELSOM	Telecommunications and IT Senior Officials Meeting
SONA	State of the Nation Address		
SOPAC	Secretariat of the Pacific Islands Applied Geoscience Commission	TESDA	Technical Education and Skills Development Authority

TFMEC	Task Force on the Measurement of Electronic Commerce
ThaiCERT	Thai Computer Emergency Response Team
THDL	Tibetan and Himalayan Digital Library
TIAC	Technology and Industry Advisory Council
TIFA	Trade and Investment Framework Agreement
TIG	Trade Information Gateway
TIGO	The Lao Millicom Company
TIP	Technology Innovation Programme
TITS	Telecommunication and Information Technology School
TOT	Telephone Organization of Thailand, now incorporated as TOT Corporation Limited
TPD	Teacher professional development
TPK	Te Puni Kōkiri (Ministry of Maori Development)
Trade SWAp	Cambodia's Trade Sector Wide Approach Policy
TRC	Telecom Regulatory Commission
TRCL	Telemedicine Reference Centre Limited
TRIDI	Telecommunications Research and Industrial Development Institute
TSTIP	Tehran Software and IT Park
TTP	Technology Transfer Program
TUANZ	Telecommunications Users Association of New Zealand
TV	Television
TVRO	Television Receive Only
TVTL	Televizaun de Timor-Leste or Television of Timor-Leste
TWB	Transactional Web Presence
TWEA	Trading with the Enemy Act
TWWW	Te Waka Wahine Wa-Hangarau — Society for Professional Maori Women in Information Technology
UBD	Universiti Brunei Darussalam
UCC	User-created content
UCSC	University of Colombo School of Computing
UGC	University Grants Commission
UK	United Kingdom
UMAC	University of Macau
UN	United Nations
UN-ASPA	United Nations-American Society for Public Administration
UNATIL	Universidade Nacional de Timor-Leste or Timor-Leste National University

UNCITRAL	United Nations Commission on International Trade Law
UNCTAD	United Nations Conference on Trade, and Development
UNDP	United Nations Development Programme
UN ESCAP	United Nations Economic and Social Commission for the Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNMIT	United Nations Integrated Mission in Timor-Leste
UnPLUG	University of the Philippines Linux Users' Group
UNSW@ADFA	University of New South Wales Australian Defense Force Academy
UNTAC	United Nations Transitional Authority in Cambodia
UNTAET	United Nations Transitional Administration
UNU-IIST	United Nations University — International Institute for Software Development
UoM	University of Moratuwa
UoP	University of Peradeniya
UPITTC	University of the Philippines Information Technology Training Center
UPOU	University of the Philippines Open University
URL	Uniform Resource Locator
US	United Sates
USAID	United States Agency for International Development
USB	Universal Serial Bus
USD	United States dollar
USF	Universal Service Fund Guarantee Ltd
USN	Ubiquitous sensor network
USO	universal service obligation
USOF	Universal Service Obligation Fund
USP	University of the South Pacific
USPNet	USP Wide Area Network
UT	Universitas Terbuka (Indonesia Open University)
UTL	United Telecom Limited
VAIP	Vietnam Association of Information Processing
VAS	Value added services

VAT	Value added tax
VCCI	Vietnam Chamber of Commerce and Industry
VCD	Video compact disc
VCN	Village Communication Network
VDC	Village Development Committee
VECOM	Vietnam e-Commerce Association
VHF	Very high frequency
VHS	Video Home System
VINASA	Vietnam Software Association
VNNIC	Vietnam Internet Network Information Center
VNPT	Vietnam Post and Telematics
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
VSAT	Very small aperture terminal
VSNL	Varat Sanchar Nigam Limited
VU	Virtual University of Pakistan
W3C (W3)	World Wide Web Consortium
WA	Western Australia
WAB	Wireless Broadband Access
WAN	Wide Area Network
WAP	Wireless Application Protocol
WAS	Web Archive Singapore
WASN	Wireless ad hoc Sensor Network Lab
WB	World Bank
W-CDMA	Wideband Code Division Multiple Access
WCPFC	Western and Central Pacific Fisheries Commission
WDM	Wave Division Multiplexing
WEF	World Economic Forum
WFB	World Fact Book (a CIA publication)
WGIG	Working Group on Internet Governance
WHO	World Health Organization
WiBro	Wireless Broadband
WiFi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WIPO	World Intellectual Property Organization
WISEPORT	Wireless-broadband-access for SEaPORT
WITSA	World Information Technology and Services Alliance
WLAN	Wireless Local Area Network
WLL	Wireless Local Loop
WMP	Workforce Mobilization Program
WSIS	World Summit on the Information Society
WTO	World Trade Organization
WWF	World Wildlife Fund
XMG	eXtensible MetaGrammar
XML	Extensive Markup Language
YD07	YouDecide2007.org
YUST	Yanbian University of Science and Technology

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Part A
Regional overviews

ICT for development in Asia Pacific: Emerging themes in a diverse region

An overview of regulatory approaches to ICTs in Asia and thoughts on best practices for the future

Managing innovation in the network economy: Lessons for countries in the Asia Pacific region

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ICT for development in Asia Pacific: Emerging themes in a diverse region

Danny **Butt** and Partha Pratim **Sarker**

In late 2008, a series of financial shocks highlighted the risks emerging from a highly networked, information economy. Governments were forced to respond quickly as movements in one financial market overnight had unpredictable effects on investor confidence in the other side of the world the next day. While investment banks collapsed or were bailed out, governments were forced to underwrite individual deposits, and reluctantly admitted that there was little that could be done to decisively reverse their nation's market fortunes or insulate them from the radical volatility of advanced economies. When advanced economies such as the United Kingdom have over 60 percent of their wealth in real estate (Hopkins 2008), sudden write-downs in value can occur as property markets fall.

It was a reminder, perhaps, that the question of development in the networked economy is far from straightforward, and the issue of wealth acquisition requires developing economies to ask: what kind of wealth? Many commentators assume that because information and communication technologies (ICTs) are equated with higher overall standards of living, then the deployment of these technologies and associated infrastructure will automatically result in higher levels of development. However, a historical view suggests that when disruptive technologies such as the Internet emerge, it is those with substantial capital who are best placed to reap the dividends (Noe and Parker 2005), and in a networked economy, this usually means those in advanced economies.

A focus on human rather than purely technological development is becoming evident from governments in the Asia Pacific region, with the aim of making the labour force globally competitive in the ICT and related industries. Localization is a key strategy in ensuring that productive workforces are retained and

developed, as this workforce becomes the most strategic asset in responding to a rapidly shifting information economy.

WHAT DO WE MEAN BY ICTD?

The field of Information and Communication Technology for Development (ICTD) now includes a vast variety of projects with many different aims and objectives. When we look at the path traveled by the term 'ICT' in recent years, its expanded coverage should come as no surprise. 'Information'—or structured data— is now widely recognized as central to economic production. Even traditional business sectors such as agriculture are increasingly reliant on human information interventions such as the genetic modification of crops or classification systems for produce. Communication technologies are a key factor in these developments as they are the means by which information is stored and circulated. ICTs are the transportation networks of the information economy, and their exponential growth and diversification are well documented in recent reports (United Nations Economic and Social Commission for Western Asia 2005).

'Development' itself is a term with many competing definitions. Most policymakers focus on macroeconomic growth as a key indicator of development; social entrepreneurs like Muhammad Yunus of the Grameen Bank emphasize access to credit and business development; and economists such as Amartya Sen (1999, p. 10) describe development in the holistic terms of personal freedom, noting that economic gains are not the only measure of effective development and that we must also examine the state's role in helping to provide: '(1) political freedoms, (2) economic facilities, (3) social opportunities, (4) transparency guarantees and (5) protective security'. Recently, trends

toward measuring and valuing development include a collective dimension outside the nation-state and the individual citizen, encompassing collective cultural development of indigenous groups (Coombe 2003) and the natural environments that support people's lives. These various aspects of development are sometimes in conflict with each other, making the terrain of development, and ICTD, a complex political field.

Increasingly, development is linked to sustainability, as economic development has often involved the use of finite natural resources and short-term economic growth may result in fewer opportunities for development in the future. Elina Zicmane (2004, pp. 8–10) notes that the European Commission defines sustainable development as 'development in which present generations find ways to satisfy their needs without compromising the chances of future generations to satisfy their needs'. She notes that a common analytical framework is the '4D' interpretation, which looks at four dimensions of sustainable development: ecological, economic, social, and cultural. 'Regardless of a separate definition of each dimension,' she says, 'all four of them are strongly linked and require a cross-cutting approach.' ('Sustainability' is discussed further later in this chapter.)

So it would be a brave person who would propose a succinct overall definition of development. However, development aspirations become clearer when we move toward the actual impact of development activities on the ground: human development. The United Nations' Millennium Development Goals (MDGs) give development this pragmatic lens, emphasizing the eradication of extreme poverty and hunger; universal primary education; gender equality; the reduction of child mortality; maternal health; combating HIV/AIDS, malaria and other diseases; environmental sustainability; and a global partnership for development.

The role of ICTs in addressing the most pressing concerns of the least developed territories is far from clear. However, we believe that in looking closely at how various technological initiatives are taking shape on the ground, we can gain a better understanding of the opportunities and risks of ICTD activities. In this respect, the Asia Pacific region provides a rich testing ground with both important success stories and instructive failures.

In this overview chapter, we outline some key concepts that are useful for considering contemporary ICTD initiatives in the region, to assist the reader in analyzing and evaluating the other chapters in this edition of the *Digital Review of Asia Pacific*. We also discuss initiatives and themes gathered from the *Digital Review* authors' meeting in Singapore in March 2008 where 50 experts from the region shared their views. Greater detail on policy initiatives can be found in the overview chapter on

ICT regulatory approaches and detail on specific initiatives will be found in the chapters on individual economies.

ICTD: THE STATE OF THE ART

An important part of the *Digital Review of Asia Pacific* is to develop more specific and nuanced scenarios of ICTD. Therefore, we must critically address the expectations of ICTD. By 'critically' we do not mean 'negatively', but simply in a manner that questions assumptions that are not matched to lived experiences on the ground. In particular, as Richard Heeks (2007, p. 1) notes, 'Very little work to date has drawn from the D of ICT4D — linking concepts in development studies to this research domain.' Our aim here is to avoid the technocratic or economistic approaches often associated with ICTD discourse from an informatics background, and to keep the people-centred view of development at the centre of our analysis.

Anita Gurumurthy and Parminder Jeet Singh (2006, p. 18) trace the idea of ICTD back to the Digital Opportunities Initiative (DOI) report authored by the US-based consulting firm Accenture, the US-based non-profit Markle Foundation, and the United Nations Development Programme (UNDP) in 2001. This report 'developed some key concepts of what came to be known as ICT4D, and… form(s) the basic framework of ICT4D thinking even today'. The view of development that the DOI report projected was market-oriented and saw development mostly in terms of dominant economic growth paradigms that have come from the developed world.[1] However, the concept of ICTD probably emerges most clearly from the first Global Knowledge conference held in Toronto in 1997 by the World Bank and the Canadian government. While international agencies such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) have been acting in this field since the 'MacBride Report' of 1980, ICTD galvanizes a new understanding about the links between communication and economic development that departs from a 'cultural' model.

As ICTD matures as a field, a number of reviews of ICTD literature that question some assumptions and embedded worldviews are beginning to appear (see, for example, Ekdahl and Trojer 2002; Wilson 2002). A key issue is that the way that ICTs are conceived has a big impact on the efficiency of development projects, and the views of ICTs of policymakers and practitioners on the ground are often different.

In particular, three 'articles of faith' identified in ICTD must be questioned if we are to learn from the work of others and not simply promote what ethnographer Eric Michaels (1990, p. 20) described as ineffective but well-meaning advancement projects, 'the discarded skeletons of which litter the countryside'. First, metaphors of catch-up, progress, and leapfrogging in the ICTD

literature present development as a linear pathway. ICT is seen as a positive, or at least neutral, influence on progression along this pathway. Second, there are common demands for urgency and the need to act quickly on ICTD in order not to be excluded from fast-paced developments. This advocacy of urgency persists even though the ranking of national human development indicators listed in the UN Human Development Reports remain remarkably stable over time. Third, assumptions are made about what kinds of information are valuable for development through the creation of the category of 'information-poor' peoples who are compared to the knowledge-holders of the developed world rather than viewed in terms drawn from their own experience.

Taking a human development and human rights perspective, we counter that no nation is inherently underdeveloped socially, culturally, and environmentally. While ICTs often drive standardization and interoperability, we cannot assume that, for example, the speakers of over 800 languages spoken in Papua New Guinea 'lack information' when their languages are not represented online (Gordon 2005). They would not necessarily benefit from a single language. It makes more sense to say that text-oriented ICTs such as the Internet are currently incompatible with many large bodies of information, particularly those held in non-dominant language groups. Rather than the deficit model common in the modernization development discourse, a more responsive approach in ICTD will mean that the socio-cultural development of peoples in their cultural environment will be given serious consideration as an opportunity for thinking about the future possibilities of ICTs.

Sein and Harindranath (2004) note that many donors and project sponsors see ICT as purely a tool for technical use, but more sophisticated projects attend to what ICTs represent or mean for users and the way this fits into the larger context of their aspirations. They see a number of different use strategies for ICTs — as a commodity, as a support for development activities, or as a driver of economic transformation — that need to be evaluated differently (Sein and Harindranath 2004, p. 20). They note that the impact can range from simple substitution of one practice for an (hopefully more efficient) ICT-enabled one, to a growth in desirable phenomena occurring because of ICTs, through to the emergence of new structures due to ICTs. These are different orders of impact, and the risk and consequences grow as higher-order change is attempted. It goes without saying that wholesale economic transformation is unlikely to occur due to a single ICTD project. ICTs are not a single neutral technology, but a complex field of activity encompassing many different technologies and various types of information that existed prior to these technologies coming into being. As Gunnar Swanson (1994) suggests about design, ICTs are 'syncretic and integrative' — they combine existing information in ways that

are new, yet also reflect prior modes of economic and social life. ICTs are not in a place that people move to from their pre-ICT world, but are a complex set of systems and protocols that link people together. ICTs are fundamentally relational.

Gayatri Chakravorty Spivak (1987), discussing ICT-enabled markets as presented in the US media, made this case very plainly more than two decades ago. She noted that while capital investors such as the Lehman Brothers are described as being able to, thanks to computers, earn 'about USD 2 million for … 15 minutes of work', this economic story writes itself upon another where 'a woman in Sri Lanka has to work 2,287 minutes to buy a T-shirt'. For Spivak, the developed economy is not a more advanced version of an underdeveloped one: they are linked through the technologically-assisted movement of people, labour, and finance capital, and the respective interests of these economies may not only be different but sometimes antagonistic. One aim of this chapter is to make clearer the differential impacts of ICTs for economically developing communities.

Globalization and Migration

It is well known that ICTs not only increase the flow of materials, products, and information through communications networks, but also facilitate greater human mobility. This human movement creates challenges for regional economic development, as it is not always clear how the benefits of ICT will remain in a local area or even a nation when they enhance the flow of talented humans away from communities. In some ways, our conception of ICTD is bound in this tension around a future that is 'global', enticing people to become more mobile, and at the same time attempting to be an impetus for benefits in local communities. This tension leads to confused planning about the actual results of ICTD initiatives.

Jeb Brugmann (2002) notes that most cities remain victims to four 'strategic flaws' that reduce the capability for sustainable development and these are particularly noticeable when looking at ICTD compared to other development initiatives. First, we tend to focus on the future rather than on strengthening existing capability.

Second, we usually attempt to avoid, rather than to address, our conspicuous institutional and political issues. Third, we tend to forget that our strategic position is also a product of routine practices and incremental decisions rather than somewhere we 'choose' to be. And fourth, as a combination of the other three, we tend to treat the market as a measure of development rather than as a tool to enhance well-being.

These suggestions encourage us to look closer at the context of development, particularly in underdeveloped regions, and to unlock the potential for sustainable development in less

revolutionary but more effective measures based on existing capacity and capability. In most regions, the rural poor are the most targeted in development programs, and addressing the social and economic issues they face will require interventions in the agricultural economy. The potential for ICT interventions is not so much to allow entry into a new economy, but to enable families to have access to health information and capital and to take better advantage of remittance economies (Richardson 2006, p. 8). As Richardson notes, the end goal of these ICT interventions is not improved agricultural production, but 'poverty reduction in the context of improved livelihoods, recognising the clear importance of the rural family as the hub of agricultural production in areas of poverty, and within national economies' (Richardson 2006, p. 9).

Ironically, by focusing on the rural family in underdeveloped areas, the degree to which local development involves global issues becomes clear. For example, remittance economies are crucial throughout the Asia Pacific region, and are radically underestimated by analyses that account only for official channels of economic trade. As Seddon et al. (2002) note, the majority of remittances are 'informal or illegal' and between 13 and 25 percent of Nepal's Gross Domestic Product (GDP) is attributable to remittances from abroad. As the bulk of the work undertaken by families abroad is service work, the remittance economy relies to a large extent on ICT skills, whether such skills are used directly in employment or as a means of connecting to a wider economic infrastructure in a host community where a migrant worker will travel.

Remittances are a very specific way in which underdeveloped communities make use of global networks, and their often informal nature should not prevent ICTD initiatives from supporting these inward flows of resources. However, supporting such family-led redistribution of resources involves less work on high-level global economy issues such as free-trade agreements that support capital mobility, and more attention to difficult political questions such as labour force mobility within and between countries.

Evaluating Gender in ICTD

Gender constitutes an increasingly important dimension of evaluation in ICTD projects. Rural economic development relies on women, who make up two-thirds of the economic activity in agricultural areas. For this reason, an understanding of gender issues is essential for effective implementation of ICTD projects. The gap between the leadership role of women in rural areas and the gender gap in ICT leadership where women lag behind creates negative impacts within the communities that ICTD seeks to assist. The bias of ICTD toward technological, global

discourse means that issues relating to families and their holistic development are sidelined, even though ICTs are often central to family life and readily used by women. This is an important opportunity for the ICTD community to address.

Initiatives such as the Association for Progressive Communication's Gender Evaluation Methodology (GEM) highlight the importance of women's experience as an analytic tool. They also identify strategies for intervention at the policy and project evaluation level. There are three questions the tool asks as a starting point for analyzing gender components (Ramilo and Cinco 2005, p. 82):

- Was there a discussion of gender issues in the project planning phase?
- What assumptions were made or research done on how ICTs can facilitate change for women and men?
- How were women or groups of women identified in the project?

These questions help clarify that gender cannot be an add-on for ICTD or relevant only to projects for women, but are central to achieving meaningful development outcomes. Indeed, it is sometimes in projects that say the least about women in particular where the questions can be most useful.

ICTD and Environmental Sustainability

It has already been noted that the issue of sustainability is being given increasing importance in ICTD. This is driven by an increasing awareness that the pace of change suggested by ICT innovation has not necessarily led to rapid improvements in the relative positions of rich and poor peoples with respect to equity and life experience (McNamara 2003). When ICTs revolutionize non-digital practices, how can we ensure that those benefits are maximized not just in the immediate present, but for generations to come? This perspective prompts us to consider the physical environments where people live and work in the information economy. These concerns become particularly pressing in an era of global warming, an unintended consequence of previous technological innovations that have been central to economic development (The Presidents of National Science Academies 2005). The potential of ICTs to reduce resource consumption — through the reduction of paper use and travel expenses and through efficiency gains — is well-known. However, the negative environmental effects do seem to be distributed to less developed countries where appropriate regulatory controls are not always in place to govern the disposal of obsolete computer products.

Grossman (2006) notes that the world generates somewhere between 20 and 50 million metric tons of 'e-waste' every year,

and that the elements that illuminate liquid crystal display (LCD) screens in portable technologies can cause damage to the brain and other vital organs. These issues are not necessarily present when we are considering ICT potential of mobile phones for example. But when we note that over one billion phones are expected to be sold in 2009, and that only 5 percent of them are ever recycled, the scale of the issue becomes clear (Huang and Truong 2008).

These waste products enter other parts of the human eco-system in ways we do not expect. For example, Weidenhamer and Clement (2007) found that some jewellery manufactured in China was highly leaded (ranging from 0.07 percent to 99.1 percent lead content), consistent with the use of recycled solder from electronics production. Such jewellery has already caused consumer deaths and, undoubtedly, there are negative effects on those working in the manufacture of these items. It should be noted that China is unique only in the scale of its manufacturing, and it has taken many legislative steps to ensure the responsible use of e-waste (People's Republic of China — Ministry of Information 2006). However, it is clear that with e-waste being increasingly sent to developing countries in the region for disposal, the issue will require stronger enforcement of regulations and sensitivity to the downstream effects of electronic production. Ironically, although ICTs can reduce the use of resources such as paper, the largest gains in resource savings occur in already resource-rich regions, while unsafe by-products are much more likely to be distributed in poorer regions.

INFRASTRUCTURE

So far, we have discussed the analytic lenses that are important in ICTD. At the level of infrastructure, connectivity has continued to dominate ICT discussion in the Asia Pacific region. Between 1999 and 2006, the number of Internet users in Asia and the Pacific increased five-fold, from two to 12 per 100 inhabitants. But this is still below the world average of 17 and far below the figures of 69 in North America and 43 in Europe (UN ESCAP 2007). Nevertheless, economies of scale and the increased number of Internet users pushed the demand in this sector from 'no or limited connectivity' to broadband and a level of 'bandwidth redundancy'. However, in 2006, there were still only three broadband subscribers per 100 people in Asia and the Pacific, compared with 20 in North America and 16 in Europe (UN ESCAP 2007).

It is not only the throughput (usually measured in bits per second) of the Internet connection that is important. The latency of commonly used satellite-based bandwidth makes it unsuitable for many services such as Voice over Internet Protocol (VoIP).

One solution for these countries has been to join consortia to install and use under-the-sea fibre optic cables. The first South East Asia–Middle East–Western Europe cable system (known as SEA–ME–WE) was introduced in 1985. Fibre optic cable was laid to establish SEA–ME–WE 2 connecting the three zones in 1994. SEA–ME–WE 3 introduced 'Wave Division Multi-plexing' (WDM) technology in 1999, connecting 39 landing points in 33 countries from Germany to Australia. In November 2005, SEA–ME–WE 4 would carry 1.2 terabytes per second (Tbps) of bandwidth. This cable system has connected 16 land-ing points in 14 countries in the three continents (Undersea Cable 2006).[2] Most of the companies that formed this con-sortium are government- or state-owned enterprises.

However, the submarine cable system does not seem to be adequate for the demand and it is susceptible to disruption of services. Thus, governments have been looking to the private sector to develop alternative or additional submarine cable sys-tems. For example, Bharti Airtel, a private company in India, is joining five other companies in Japan, Malaysia, Singapore, and the US to build a high-bandwidth, undersea fibre optic cable linking Asia and the US, to go live in 2010. The Bangladesh government has also decided to allow a second submarine cable financed by the private sector to maintain uninterrupted over-seas voice and data communications and to back up its existing undersea cable.

Google is involved as a service provider and non-telecom investor in all three additional under-the-sea fibre optic networks that connect the US with the Asia Pacific region, marking a significant shift in funding models for data. The Trans-Pacific Express Cable System is going to connect the US with China, the Republic of Korea, and Taiwan. The Asia–America Gateway Cable System, which is being planned to come on service in the first quarter of 2009, will connect the US and several South Asian countries. The third cable is being planned by Reliance FLAG with a speed of 2 × 1.28 Tbps. When operational, these three cables will change not only the present landscape of bandwidth capacity, but also the price regime of connectivity in the Asia Pacific region, leading to further multimedia- and connectivity-based services in the region. The unknown economic question is whether the region is a net consumer or producer of such services.

In parallel to these external connectivity opportunities, there is a push by national governments to add capacity, and share or build up backbone infrastructure. In some landlocked countries such as Nepal and Cambodia, government-owned telecom entities are laying out fibre optic backbone connecting to the nearest country that has access to under-the-sea cable. Afghanistan is building its national fibre optic backbone following the national ring-road infrastructure and is planning to connect this with

under-the-sea cable through Iran, Turkmenistan, Uzbekistan, Tajikistan, and Pakistan.

Some governments are making it a licencing obligation for service providers to rollout to rural areas. For example, in Pakistan, the private sector has led the expansion of three new nationwide optical fibre systems. One private telecom entity in Sri Lanka already owns a nationwide fibre network that is supplemented by Worldwide Interoperability for Microwave Access (WiMAX) technology for broadband to the door. The Indian government has directed the private incumbents to extend the network to rural areas (Samarajiva and Zainudeen 2008).

As the chapters on individual economies in this volume show, investment vehicles are being developed so that costs can be shared by various entities using the infrastructure. Australia has developed a hybrid plan where private companies would provide the infrastructure to the populous areas and government funding would make feasible the rollout of services to most regional, remote, and rural communities. The Bangladesh government has recently signed a deal with the Power Grid Company of Bangladesh Limited to provide backup fibre optic network to the existing one.

Different governments in the region are also making substantial political commitments to broadband expansion, which is making investment in backbone infrastructure more viable in areas that were not commercially viable earlier (Samarajiva and Zainudeen 2008). For example, the Indian government is expecting 20 million broadband connections by 2010 and plans to ensure broadband connectivity in every school, health centre, and Gram Panchayat (local government units). Digital Subscriber Line (DSL) users in Pakistan now number 100,000, and the target is to reach 1.6 million in 2009. The National Telecommunications Commission of Thailand has already granted 12 licences for operators to conduct commercial trials of broadband wireless access and allocated frequency for this. The Malaysian government's Information, Communication, and Multimedia Services 886 Strategy (MyICMS 886) talks about eight new services to build up eight essential infrastructures that includes high-speed broadband. In the Republic of Korea, the IT839 strategy consists of the introduction of eight new services that it is hoped will prompt investment in the building of three essential networks. The synergies here are aimed at stimulating nine new sectors, including intelligent services and home networks. Notable is the link between enabling infrastructure and technology and the clear identification of the economic sectors to be stimulated, even if such outcomes are not always determined in advance (Shin 2007). Some of the roles governments can take in stimulating infrastructure are taken up further in the overview chapter on ICT policy.

At the logical layer of Internet infrastructure — between the hardware and end-user applications — changes are also occurring as many Asian countries are introducing next generation Internet protocol, Internet Protocol version 6 (IPv6), which allows greater flexibility in assigning addresses. IPv6 can support a bigger set of 3.4×10^{38} (340 undecillion) unique addresses while Internet Protocol version 4 (IPv4), which is still widely used, was designed to provide about four billion unique Internet Protocol (IP) addresses. China, Japan, the Republic of Korea, and Taiwan have been at the forefront of the first wave of IPv6 deployment, while the second wave has been led by Australia, India, Indonesia, the Philippines, Thailand, and others. One of the motivations for Asian countries to move to IPv6 was that Asian countries control only 9 percent of the allocated IPv4 addresses while they have half of the world's population. However, even though the protocol has been ratified for some time, IPv4 remains widely used and the challenges in stimulating widespread uptake point to the unusual governance questions that arise in an Internet environment with decentralized authority, as there are no incentives for managers of core infrastructure to deploy the new protocol.

Mobile and Wireless

While fibre optic cable is still the dominant technology for backhaul within and between countries, the 'last mile' of connectivity is increasingly wireless. The Republic of Korea launched the world's first Code Division Multiple Access (CDMA) 2000 1x3G network in October 2000 and Japan launched the world's first Wideband Code Division Multiple Access (W-CDMA) 3G (2 Mbps) network in October 2001. It is important to note that CDMA2000 and W-CDMA are types of third generation (3G) cellular network that refer to mobile communications with roaming capability, broad bandwidth, or high-speed communication (upwards of 2 mbps) and represent a shift from voice-centric services to multimedia-centric ones. China, on the other hand, has developed its own 3G technology standard — Time Division-synchronous Code Division Multiple Access (TD-SCDMA) — to reduce its dependency on western standards.

Although W-CDMA is the fastest growing technology in the richer economies of the Asia Pacific region (e.g. Hong Kong, Japan, the Republic of Korea), in other parts of Asia, such as in South Asia, CDMA2000 is experiencing substantial growth. India made an interesting example by not grouping 3G services with the older second-generation (2G) services and by offering its available radio frequencies not only for 3G services, but also for WiMAX services. A typical 3G or WiMAX mobile network can deliver very high-speed connectivity that can enable the network to run a variety of applications such as

video telephony, video conferencing, mobile TV, interactive gaming, streaming video, music downloads, and mobile TV on a hand-held device.

In some other countries, like Indonesia, the government has taken the initiative to introduce local WiMAX service after the 3G service is rolled out by private operators. The government there is introducing 2.3 GHz local WiMAX using the Ministry of Post and Telecommunication network. But for many other countries, this WiMAX deployment is much more private sector-led. Taiwan, for example, has already issued licences to six operators to deploy WiMAX throughout the country by 2008. Global network performers such as Nortel and Intel have been deploying WiMAX service in South-East Asian countries. It is expected that by the end of 2009, Asia Pacific WiMAX subscribers will account for 45 percent of the total subscribers in the world. WiMAX services are rolling out very quickly in countries where 3G services are not yet available. For example, Tata has rolled out one of the largest WiMAX networks in the world at 3.3 MHz in 10 Indian cities, including Bangalore, Chennai, Delhi, Hyderabad, and Mumbai.

The 2007 UN ESCAP report suggests that at least three economies in the region (Macau SAR, Hong Kong SAR, and Singapore) have more than one mobile cellular telephone per person. The Maldives, along with China, India, and Macau SAR, registered the most notable increases in the absolute number of mobile phone subscribers in the last few years (see the relevant chapters in this volume).

Technological Developments (Including Convergence)

The development of bandwidth infrastructure described earlier enables new forms of connectivity and also responds to demand coming from new applications (particularly audio-visual content delivery). Technological convergence continues as device manufacturers, software suppliers, traditional telecommunications companies, mobile operators, content companies, social networking companies, and providers of new wireless infrastructure jostle for position in determining the content and services that are delivered through ICTs. This leaves ICTD practitioners in a difficult position as ICTs are reliant on standards and multinational companies attempt to become 'default standards', often leaving standards bodies and governments catching up in a reactive mode.

Vickram Krishna believes that 'the recent development and commercial launches of ultra-compact low-energy consuming network-ready devices, such as the Asus EEE PC available at stunningly lower price points than previous "advances" in computing platforms, is seminal' (Vota 2007). The same is true for

the One Laptop per Child (OLPC) XO and the Intel Classmate PC that are integrating features such as durable rugged design, flash memory (rather than hard drives), rechargeable power systems, built-in multimedia and wireless devices, and the like. These devices are competing with each other to get access to poor underserved classrooms of children, although there are substantial debates about total cost of ownership and the long-term suitability of these solutions for the least developed countries (Vota 2007). A case study in India, for example, shows that the introduction of computers in schools has resulted in the misallocation of resources and neglect of infrastructural facilities, which should be a higher priority (UNDP 2004).

At the other end of the scale, the rise of feature-rich, application-centric multimedia handsets led by Apple's iPhone model are rapidly changing the market. While many of these features are designed for more affluent users, they have the effect of setting the agenda for convergence and establishing models for associated service delivery that drive standards development. For example, the bundling of Google's video streaming application YouTube and mapping applications helps cement these sites as default platforms for such services. YouTube, for example, launched an Indian site with local content partners on 7 May 2008; many other territory-specific versions of the platform are being developed. As the iPhone begins an unprecedented rollout to over 46 carriers in 42 countries through 2008 (Elmer-DeWitt 2008), its importance, like that of the iPod before it, will be not only in terms of the volume of sales it makes, but also the way it shapes the market for telecommunications and integrated digital content. Asia Pacific is the world's largest market for smart mobile devices, accounting for 46 percent of worldwide shipments of 23.2 million in the first quarter of 2007 (Burns 2007).

Overall, the convergence of audio, video, and Internet content is rapidly reshaping the media experience in the region, and Internet networks and new ICT devices are central to the new content distribution platforms. Because national governments and content owners have little control over the development of standards used in integrated devices, there will be a number of challenging issues for content regulators and traditional content business models.

EDUCATION AND HUMAN DEVELOPMENT

This edition of the *Digital Review* has a number of chapters on ICT for education, and here we briefly touch on some of the larger trends. Given the awareness-raising and catalytic role of access to information for development, programs to eradicate illiteracy and support non-formal education through the

increased use of ICTs such as radio, television, and the Internet are important. Furthermore, the development of the ICT sector in general depends on the preparedness and capacity of the critical mass who are the users, innovators, and developers of ICT applications in specific settings. Therefore, capacity and human development through ICT education remain a key policy focus for Asia Pacific countries.

In Brunei, for example, the Ministry of Education is involved in designing different programs related to ICT training and have introduced 'e-learning systems' in all higher academic institutions that standardize Web technologies for creative learning environments. The Government of the Republic of Korea actually launched a separate program called the 'IT Education and Training Plan for 10 Million People' in 2000 where they educated 13.8 million Koreans, including many employees of different government organizations. In 2004, they launched another program, called 'Mid- to Long-Term Plan for Reducing the Digital Divide', where a key objective has been to develop computer literacy and capacity by offering different training programs. The Thai government has supported the availability of cheap computers (USD 230 per computer with a monitor) in the country and its introduction in different education institutes.

These examples indicate that many governments in the region are committed to the 'development of ICT' by providing hardware, laying out infrastructure, and offering ICT training courses. This comes from a historical understanding of ICT as an independent field. But policies are being developed that respond to ICT as an enabling platform that crosses many fields. For example, the new Australian government's 'education revolution' policy not only discusses ICT capacity development in all secondary schools, but also acknowledges that 'computer technology is no longer just a key subject to learn, it is now the key to learning in almost every subject'. The policy also aims to provide broadband or equivalent connection and one computer for each child in all secondary schools in Australia.

Almost all countries in the Asia Pacific region have advanced programs in computer education, particularly at university or higher education levels, and it is interesting to see that some countries do not necessarily have such programs at the lower levels. Take the example of the Maldives, Mongolia, Myanmar, and Nepal. Maldives College started to offer degree programs in Information Technology (IT) in 2005 and Villa College has been offering courses in computing and IT since 2007. In Myanmar, the University of Computer Studies in Yangon and the University of Computer Studies in Mandalay have started to offer degrees in computer science. On the other hand, countries such as India have emerged as pioneers in IT education and have been franchising their IT education businesses in different Asian countries using brand names such as Aptech and NIIT.

One of India's most renowned IT institutes, the Indian Institute of Information Technology (IIIT), Bangalore, has started to make its science and engineering courses freely available on YouTube (youtube.com/nptelhrd.com) on a trial basis (Rebello 2008). The project is part of the National Project on Technology Enhanced Learning (NPTEL), a joint venture between the seven IITs and the Indian Institute of Science funded by the Ministry of Human Resource Development.

MEDIA AND CONTENT DEVELOPMENT

User motivation to access content and services is the key to the survival of infrastructure or the adoption of a technology platform. Whereas in the past it may have been adequate to build infrastructure or promote last-mile technology solutions, policymakers increasingly recognize that issues such as software localization and production of digital content are critical to the development of sustainable demand for ICTs.

There are two prominent drivers of these processes. As more governments go online in line with their e-government policy, there is an increasing demand from the citizens to get content and related services in their local language. Users also have an increasing appetite for digital content and this has fuelled the growth of the three main online content markets: music, videos, and games.

In the *2003–2004 Digital Review of Asia Pacific*, challenges in content development were identified in terms of tools, standards, human capacity, financial models, political culture, and legal frameworks. Although many of these challenges still exist, there have been many developments in the availability of some technical standards (such as Unicode) for many Asian languages and in the action plans of governments to include development or access to content as part of their policy framework. The PAN Localization Project, for example, has made considerable progress in developing the LINUX operating system in Nepali (Nepal) and in Dzongkha (Bhutan); optical character recognition and text-to-speech software in Sinhala (Sri Lanka), Bangla (Bangladesh) and Lao (Lao People's Democratic Republic); and a wide range of supporting applications and utilities, such as lexicons and fonts, in languages such as Khmer in Cambodia, Pashto in Afghanistan, Tamil in Sri Lanka, and Urdu in Pakistan. The project is also supporting more localization standards/tools that are being developed in Mongolian (Mongolia), Tibetan (China), and Urdu (Pakistan). In many countries such as the Republic of Korea and Vietnam, the localization process is led by different private companies that enjoy support from the government. The Vietnamese language

has been standardized to Unicode UTF 8 by the Vietkey Group in Vietnam. Some other native languages of Vietnam, like Thai, Cham, Jarai, Bah'nar, Êdê, M'nông, Sê dăng, and K'hor are also in the process of Unicode standardization.

In many cases, government initiatives are important in spurring localization, particularly for minority language groups that may not yet constitute a sizeable market for ICT products. The Indian government has set up the Centre for Development of Advanced Computing (C-DAC) that has developed a localization framework for different Web applications, desktop-based applications, localized browser solutions, and the like. The Australian government has put policy emphasis on getting some endangered indigenous languages online as part of its digital content policy. The Afghan Computer Science Association has converted Microsoft Windows XP and Office 2003 into the Pashto language. And the Cambodian National Committee for the Standardization of Khmer Script in Computers (NCSKSC) has been instrumental in sensitizing the need for localization, introducing Khmer scripts in different government offices and offering ICT training programs in the Khmer language.

In Sri Lanka, all government websites are required to be multilingual (in Sinhala, Tamil, and English) and to use Unicode fonts. The Bangladesh government is working to enact the Right to Information Act that would enable more government information to be easily available on demand. India passed a Right to Information Act in May 2005. In Pakistan, an ordinance was promulgated in June 2002 ensuring people's access to information. All these would mean that content services from the government side would be a focal point of citizen's demand in the coming years.

Localization is often pioneered by local volunteers and self-help groups in distributed networks, often without a formal organizational structure. The Bangladesh Open Source Network is an informal network that has not only developed a Bengali interface or version of different applications (such as Ubuntu Linux, Mozilla Firefox) in the local language, but also promoted localization through training camps in different institutions and by facilitating Bengali content development at Wikipedia. As of January 2008, Bengali Wikipedia has over 16,000 entries, one of the highest in the non-English language versions of Wikipedia. Sinhala Unicode Communities is a volunteer network in Sri Lanka that has been involved in promoting the use of Unicode in Sinhala and was supported by several freelance bloggers who organized themselves into community journalism forums to promote local content.

As the cost of access is reduced, we see an increased number of users producing and distributing content through blogs or short/multimedia message service (SMS/MMS) to connect and empower people through campaigns and action. In countries

where the press enjoys little freedom, posting and reading content anonymously on the Internet have become an important source of media coverage. In Iran the number of Persian blogs run by Iranians is estimated to be around 800,000 this year, a 30 percent increase since the last year. In China, the population of bloggers is growing rapidly.

Digital content makes for a booming music, video, games, and animation industry. A recent report of In-Stat's Consumer Media and Content Service found that by 2011 in the Asia Pacific region online music revenues will reach USD 1.4 billion, video revenues will reach USD 2.7 billion, and the game industry will exceed USD 9.5 billion (Potter 2007). The question is how much of this revenue will remain in the economies in question and how much will travel to rights-holders outside the locality of sale. The importance of viable locally-owned content markets is reflected in the increasing emphasis on the creative industries in economic development strategies.

CONCLUSION

The pace of change in ICT continues to be intimidating for those seeking to make new innovations available for all. It seems that as soon as new bandwidth becomes available, new audiovisual services, which require ever more data, become the norm. The challenges for policymakers and for development practitioners are similar: how to make sense of it all and determine the best way to prepare stakeholders to benefit from these applications? When infrastructural issues develop so quickly, it is not simply a case of rolling out 2G, 2.5G, 3G, 4G, on the pathway toward development. Instead, the decision to implement the conditions for certain technologies always has an eye to the past (embedded capability and capacity to use new technologies) and the future (ability to build on the experience with learning that will be sustainable).

The Asia Pacific region is uniquely positioned with respect to ICTD. It is home to the largest manufacturing capability for ICTs, yet it is also home to over half the 1.6 billion people in the world who live without electricity (UNDP 2007). The region includes nations such as China that are undergoing rapid economic growth, and highly developed nations whose economies are adapting rapidly to the high-technology manufacturing capabilities emerging in other areas. It also includes nations facing severe development challenges and structural poverty that will not be easily solved. The region has been in the media spotlight due to recent natural disasters, as well as the technologies that are being deployed to mitigate their effects. And the Asia Pacific region contains most of the world's languages and a growing infrastructure for cultural exports —

a fact that ought to have some relevance for the focus on cultural development and creative industries such as digital content.

While it is difficult to generalize about the position of the Asia Pacific with respect to ICTD, the chapters in this edition of the *Digital Review* show that the different parts of the region have much to learn from each other, even as the region as a whole must respond to critical decisions that might be made in North America or Europe regarding device standards. In the technology sector, we are used to valuing the cutting-edge and innovative. But in the realm of development the promises of ICTs must be tested against their effects on human development in our specific locations in the Asia Pacific region. As ICTs continue to change the structure of economies and the processes of globalization, governments and communities will need to respond in ways that take into account the important and complex issues that go to the very heart of development.

NOTES

1. See DOI report at http://www.opt-init.org/framework/pages/contents.html
2. The 16 companies that form the consortium include Algeria Telecom (AT), Bharti Tele Ventures (India), Bangladesh Telecom (BTTB), Telecom Thailand (CAT), France Telecom, MCI, Pakistan Telecom (PTCL), Singapore Telecom (SingTel), Sri Lankan Telecom (SLT), Saudi Telecom (STC), Telecom Egypt, Telecom Italia Sparkle, Telecom Malaysia, Tunisia Telecom, VSNL (India), and Etisalat (UAE).

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An overview of regulatory approaches to ICTs in Asia and thoughts on best practices for the future

Rajesh **Sreenivasan** and Abhishek **Singh**

INTRODUCTION

This chapter has two objectives. First, it provides an overview of the themes evident in the regulatory approaches taken toward information and communication technology (ICT) policy in various Asian jurisdictions. In doing so, the chapter draws on the chapters on individual economies published in this edition of the *Digital Review of Asia Pacific*. Second, it conducts an in-depth analysis of policy approaches to four areas of growing importance in the digital realm.

In the first part of the chapter, we juxtapose the regulatory approaches in developed and developing Asian jurisdictions. In the second part, we take a more in-depth look at e-government services, the role of ICT policy in improving access to education, the growth of open source software in the region, and the growth of localized and indigenous digital content and its regulation. We focus on the best practices that regulators might consider adopting in regard to these four areas that we view as pillars of ICT policy in a number of jurisdictions in Asia.

THEMES IN REGULATORY APPROACHES TO ICT IN CERTAIN ASIAN JURISDICTIONS

In this section, we briefly examine the themes in regulatory approaches to ICT, particularly in regard to key institutions and organizations dealing with ICTs and key ICT policies, thrusts, and programs, in developed and developing jurisdictions in Asia. Developed jurisdictions, which include Japan,

South Korea, Singapore, and Taiwan, have relatively mature ICT markets with definite plans (some already in execution phase) to put in place next generation infrastructure, multiple competitors in a market, and market demand for services and products healthy enough to encourage innovation. Developing jurisdictions include countries where ICT markets are growing rapidly due to economic prosperity and large populations capable of sustaining such growth, but where this has been a recent phenomenon (e.g. China and India), as well as countries whose economies and ICT take up is not expanding at a rapid pace due to their small population and market sizes, relative geographic locations, and/or economic size.

Key Institutions and Organizations Dealing with ICT in Asia[1]

Both developed and large developing markets have a higher number of key government institutions and organizations dealing with ICTs than the small developing markets. In Hong Kong, for instance, there is the Commerce and Economic Development Bureau, Office of the Government Chief Information Officer, Office of the Telecommunication Authority, Innovative Technology Commission, Hong Kong Applied Science and Technology Research Institute, Broadcasting Authority, Hong Kong Internet Registration Corporation Limited, Hong Kong Science and Technology Park, and Hong Kong Cyberport Management Company Limited (which is wholly owned by the Government of Hong Kong). In Japan, there are a number

of ICT sector initiatives under the Prime Minister's Office, Ministry of Internal Affairs and Communication, and Ministry of Economy, Trade and Industry. Singapore has the Info-Communications Development Authority of Singapore (IDA), Media Development Authority of Singapore, Interactive Digital Media Office, Ministry of Information, Communications and the Arts, Singapore Infocomm Technology Federation (SiTF), Economic Development Board, Attorney-General's Chambers, and a number of universities and polytechnics actively engaged with the ICT sector.

The same appears to be true in a number of large developing ICT markets. For instance, China has, among others, the Ministry of Information Industry, the China Internet Network Information Center (a body under the Ministry of Information Industry), the Chinese Academy of Sciences, and within it the Computer Network Information Center, and the Secretariat of the Internet Policy and Resource Committee under the Internet Society of China. India has the Ministry of Communications and Information Technology, within which operate the Department of Telecommunications and the Department for Information Technology, the National Knowledge Commission, the Centre for Development of Advanced Computing, the Controller of Certifying Authorities, and the Cyber Regulatory Appellate Tribunal.

The picture changes when one looks at developing ICT markets that have smaller economies and are only recently becoming more integrated into the globalized demand and supply chain. For instance, in Afghanistan, there is only the Ministry of Communications and Information Technology and the Afghanistan Telecom Regulatory Authority (ATRA). In Cambodia, ICT projects are overseen by the National Information and Communication Technology Agency and the Ministry of Commerce. In the Maldives, there is the Telecommunications Authority of Maldives and the National Centre for Information Technology.

Vietnam, however, is an interesting case in that it has taken a number of steps characteristic of a rapidly developing ICT market. In 2007 the Vietnamese government created the Ministry of Information and Communication by merging the Ministry of Post and Telematics with parts of the Ministry of Culture and Information. There is also ICT-related work being carried out in the other Ministries, such as the Ministry of Science and Technology. They have also recently passed legislation and guidelines aimed at providing a clearer regulatory regime for ICT:

> ICT-related laws that took effect in 2006 include the Law on Electronic Transactions (by Decision No. 51/2005/QH11 of the National Assembly), the Law on Information Technology, the Law on IPR (by Decision No. 28/2005/L/CTN)

that has a special section on software development, and the Decree on e-Commerce No. 57/2006/ND-CP. As such, it can be said that 2005–2006 was when a strong legal foundation for ICT development was laid in Vietnam. (Tran and Nguyen, this volume)

To concretize these laws and decrees, more specific regulations were enacted in 2007. The more notable among these are:

- The regulation regarding financial management of funds for public telecom services.
- Directive No. 04/2007 enhancing the protection of copyright on software.
- Decree No. 26/2007 on digital signatures.
- Decree No. 35/2007 on electronic transactions in banking.
- Directive No. 03/2007 enhancing information security over the Internet.

Why has Vietnam suddenly become proactive about putting in place regulation for its ICT market? The answer perhaps is that necessity is the mother of invention, but in this case, necessity is felt only when a government starts to see the tangible benefits of rapid economic growth, as Vietnam has witnessed in the past few years, with a lot of this growth attributed to inward bound foreign investment.[2]

But is increased interest from foreign investors the catalyst for putting in place clear and stable regulation and legislation in ICT sectors in developing countries? If so, why? Is it because a number of smaller developing countries rely on strong supply side equations in developed countries to drive their own internal engines of growth? Is it because their own population's per capita is too low to expect an indigenous demand high enough to drive growth? These questions are beyond the ambit of this paper, but they might make for an interesting study in the ICT context.

Key ICT Policies, Thrusts, and Programs in Asia[3]

The observation one draws from looking at the thrust of ICT policies and programs in developed versus developing ICT markets is primarily that developed markets, along with China, appear to be grappling with issues related to expanding the size of the local ICT markets. There seems to be a particular emphasis on promoting inclusive ICT growth, with the aim of increased ICT use across all income strata and demographics. Meanwhile, in developing markets like Afghanistan, Cambodia, and Vietnam

the thrust appears to be on the build up of infrastructure and competencies in ICT sectors where they feel they can be competitive in the global marketplace.

For example, Hong Kong has the Digital 21 strategy promoting wireless hotspots in government premises and free wireless broadband at public housing estates, the Hong Kong Qualifications Framework for increasing the sustainability of the ICT sector, the Sector Specific Programs policy, and the Digital Solidarity Fund. In Singapore, IDA has launched a fairly comprehensive set of initiatives aimed at improving the ICT readiness and competitiveness of small and medium-sized enterprises (SMEs), as well as programs to increase ICT penetration and awareness across all sectors, including programs like the Assistance on Commonly Used Software, SME Infocomm Resource Centre, Technology Innovation Program, and Local Enterprise Technical Assistance Scheme; the NEU PC Program, Silver Infocomm Junctions, and Infocomm Accessibility Centre; the National Grid Pilot Platform; the Infocomm Security Masterplan; and the Intelligent Nation 2015 Masterplan or iN2015. In Afghanistan, the key policy thrust over the past few years has been on building up infrastructure, as well as trying to attract business process outsourcing start-ups to locate in Afghanistan where the cost of personnel and infrastructure is relatively low compared to other jurisdictions.

In Singapore and Japan, there appears to be importance given to regulating dominant players. Japan has announced the commencement in 2010 of discussion about the regulation of Nippon Telegraph and Telephone (NTT) as the dominant telecommunications player. IDA Singapore is implementing the Code of Practice for Competition in the Provision of Telecommunications Services 2005, particularly in regulating the position of Singapore Telecommunications (SingTel) in the Singapore market. These suggest an implicit agreement by the regulators in these countries of the need to seriously consider the role of dominant players in building a telecommunications and technology sector that is competitive in an environment characterized by technology-driven paradigm shifts in business models. Increasing the competitiveness of the ICT market requires a willingness to experiment and take risks that a dominant entity with stable cash flows from its own internally determined investments and infrastructure might not be willing to make. In short, some dominant entities might have financial interests that are not aligned with acting in the best interests of increasing the competitiveness of the ICT market. Hence, there is the need to regulate such entities.

Many developing countries are not yet focusing on these kinds of issues, as they concentrate on building ICT infrastructure to ensure a suitable foundation presumably for subsequent

development of their ICT markets to developed country standards. That said, it is refreshing to see Articles 21–24 of the Afghanistan's Telecommunications Services Regulation Act dealing head on with the issue of competition. Crafted in the broad language of primary legislation, the articles nonetheless deal with the issues of anti-competitive conduct and abuse of a dominant position at a high level. They may require subsidiary guidelines to provide the Afghan ICT market with guidance on how the relevant authority (the ATRA) intends to interpret and apply these articles.

KEY ISSUES SHAPING THE REGULATORY APPROACH TO ICT MARKETS IN ASIA

This section of the chapter looks at the four key issues that we believe will play an instrumental role in shaping ICT regulatory approaches in several jurisdictions in Asia. The four issues are:

1. Citizen-focused e-government services;
2. ICT regulation and policy's role in improving access to education;
3. Open source software's continued growth in the region; and
4. The availability of localized digital content and its regulation.

Citizen-focused e-Government Services

'E-Government' services refers to the provision of government services, from taxation and licensing through to passport application and issuance, via electronic means. While the overall concept of e-government can often have a wider meaning,[4] we use this limited view of e-government because it offers a minimum threshold of e-government or a common baseline goal for e-government services that any government should aspire to.

E-Government has come a long way in Asia, from basic computerization of government records to a stage where at least in developed ICT markets, the availability of e-government services is a given. Governments and regulators in these markets must now think about the next stage of evolution as technology and penetration rates expand the scope of possibilities and service delivery channels for e-government services.

As may be expected, the state of e-government services in different Asian jurisdictions depends in large part on the stage of development of the ICT market in those jurisdictions. Generally, the more developed the ICT market, the greater the capability of regulators. This is due to the added experience garnered from

facing and resolving a greater range of issues in deeper and more developed ICT markets.[5]

Singapore and Japan provide an interesting contrast in terms of the content and timing of their approaches to e-government services. Singapore has had a long and reasonably fruitful experience with e-government. It has long passed the need for developing policies enabling the delivery of basic e-government services,[6] and is now grappling with the issue of how to deliver e-government services as seamlessly as possible over multiple channels in a bandwidth-rich and increasingly bandwidth-irrelevant environment (in the case of bandwidth-intensive applications). This is evident from the kinds of policies the government is pursuing under iGov 2010, such as issuing unique establishment identifiers, rollout of services via the mobile phone channel, and build out of a common operating platform across all ministries and departments responsible for the provision of e-government services to ensure a seamless user experience and a unified backend.[7]

Japan began thinking about the large-scale deployment of e-government services around 1994 and seriously started implementing e-government programs around 2000, which seems surprisingly late for a 'technology leader'. Given the high levels of technology infrastructure and penetration rates prevalent in Japan, it is not surprising that the primary focus of e-government policies is similar to that of governments and regulators in other ICT leading jurisdictions such as the Republic of Korea, Singapore, and Taiwan. Specifically, Japan is concerned with refining the user experience of e-government services as well as unifying the backend to enhance processing times and lower costs for the government.

The picture looks a little different, but reasonably encouraging, in China and India. China and India's paths to ICT market development and e-government adoption have been somewhat counter-intuitive. In China ICT development and e-government adoption were a result of the Politburo's belief in the virtues of effective computerization as a means of achieving progress. Early policies encouraging computerization and the adoption of information technology as a tool for more efficient governance ultimately paved the way for the growth of the ICT sector. In contrast, in India the ICT sector grew because the government never seriously regulated the sector, allowing the entrepreneurial spirit and elusive providence to work together without over-regulation driving a wedge between the two.

That said, both China and India have work to do to catch up with developed Asian jurisdictions in e-government. While both countries have made headway in the computerization of government backend, they have some way to go before a streamlined suite of government services will be available. To be fair, this has as much to do with the size and added complexity of

larger jurisdictions as with political will and priority government agendas. Additionally, in China and India improving technology penetration and literacy rates in rural areas is arguably a higher priority than focusing resources on rolling out a flawlessly functioning suite of e-government services.

Something that both governments should try to get done sooner rather than later is to improve access to information and transparency in government decision-making through the use of ICT. There is arguably real scope for curbing corruption if there is political will to implement systems that enable the public to access information and trace government decisions to individual civil servants at all levels (Bhatnagar 2004). Political will is the key to making such a system work, from the minister ordering system implementation, to the civil servant who needs to submit data on decisions, to his or her superiors who must resist the temptation to doctor publicly accessible data entries where there appears to be incentive to do so and there is no means of tracing any actual tampering of data entries. India has made progress in this regard with the enactment of the Right to Information Act 2005 (IRTI Act). However, there remains under Section 8(1) of the IRTI Act significant discretion vested in the public authorities to refuse disclosure of certain information. While most of the grounds for refusal are valid (such as confidential information that may adversely impact national security or undermine sovereignty), certain provisions, such as Sub-sections 8(1)(d) and (e) — where the 'competent authority [i.e. the relevant government department] is satisfied that larger public interest warrants the disclosure of such information' — could be used to arbitrarily deny requests for information. Admittedly, there will always be discretion involved in the disclosure of information, as what information is revealed, at least in some cases, is a political choice.

Countries like Singapore and Japan on one hand, and China and India on the other hand, can learn from each other the virtues they have each developed in their respective geopolitical realities. The developed ICT markets of Japan, the Republic of Korea, Singapore, and Taiwan share the common factor of being relatively small countries with relatively small domestic markets (except for Japan). In contrast, China and India are very large markets and therefore more complex, with a far higher volume of data points, increased dispersion around the mean due to the existence of multiple economic sectors with different averages and income scales, and increased skewing at the lower end of the income scale. All these amount to a more unpredictable environment for planning e-government services across a range of diverging and increasingly competing sociopolitical objectives. Specifically, in China and India, large disparities in income means e-government service choices that benefit one segment versus another, and it becomes difficult

to justify these choices to a segment for which they pose no significant tangible benefit. For example, consider the policy choice between allocating limited resources to the development of an e-government procurement portal for agricultural produce and the development of a portal designed to make it easier to apply for venture funding from a government-backed incubator. Which agency gets the requested funding? How is the choice justified?

Nevertheless, China and India can learn from developed ICT jurisdictions how to formulate implementable policy and how to develop the talent to decisively execute such policy. These two factors would arguably form part of any equation of success in an e-government services strategy. On the other hand, what the regulators in the developing markets of China and India can teach the developed ICT jurisdictions is how to formulate policy that needs to be coordinated across state and federal levels, and that impact far larger and more diverse populations and markets than a relatively small domestic market. This can help regulators in developed ICT jurisdictions to incubate and develop the domestic ICT talent seeking to build or improve its competitive position in global markets.

This section on e-government has been deliberately selective in looking at the state of e-government in developed ICT markets and the developing markets of China and India. It has not taken an in-depth look at the markets lying between these two points on the ICT development continuum, such as Indonesia and the Philippines, where e-government deployments have been on a lesser scale and where the full potential of such services has yet to be realized. We now turn to the issue of ICT regulation and the role of policy in improving access to education.

ICT Regulation and Improving Access to Education

That ICT can play a substantial enabling role in improved delivery of education is well accepted in Asia. In this section, we wish to highlight the idea that regulators concerned with access to education should be aware that ICT policy must act in coordination with other policies that address the basic social, cultural, and economic issues associated with improving access to education. For example, a policy focused on increasing computerization in schools by itself would arguably have far less impact than if it were coordinated with a policy to make computers and technology more affordable. One can go further and argue that an effective way to tackle the issue of affordable access would be to take a strong stance encouraging competition at all levels in the information technology supply chain, regardless of the nationality of any participant with significant market power. Such an approach would perhaps lower prices more effectively than a plan to subsidize technology purchases

for lower income households. Similarly, and more directly linked to the issue of computerization of schools, is whether there exists a clear policy on ICT competencies for teachers as well as for continuing teacher professional development in technology integration.

The other obvious advantage ICT policy offers is the possibility of increasing access to education through distance learning. Coupled with a drive to increase access to computing technology in rural and less urbanized areas, this could broaden access to education for all. (See the chapters on '*Education for All* in the Digital Age' and on 'Distance Education in Asia Pacific' in this volume.)

However, there are still a number of questions about whether and to what extent ICT use in education is beneficial without due consideration of its actual impact on student learning and curriculum goals. One pertinent critique from a 2005 study of ICT in education policy in Organisation for Economic Co-operation and Development (OECD) countries has been that education planners and technology advocates think of the technology first and then investigate the educational applications of the technology later. A case in point: tablet Personal Computers (PCs) can be beneficial in educational settings, but their Liquid Crystal Display (LCD) screens are not as easy to read as paper.[8] This raises the more abstract but nonetheless important policy question of how computers would be integrated into curricula at all education levels (primary, secondary, and tertiary) and how teaching practices would have to be modified or adapted. The same study also notes that there is little compelling or unequivocal data to back up the belief that 'ICTs can empower teachers and learners, promote change, and foster the development of 21st century skills' (Trucano 2005).

We do not believe that this implies that any policy seeking to promote the use of ICTs to improve access to and the quality of education is doomed to failure. On the contrary, we believe that this critique strengthens the case for regulators to take a more coordinated and holistic approach to devising ICT in education policy and regulation. Such an approach would address several questions. First, what are we seeking to achieve? Second, what factors need to be in place in order for technology use to benefit users and students (e.g. improving ICT penetration rates in rural areas)? Third, what can be implemented with minimal administrative delay and to the greatest effect?

Also, given the critical role of education in any country especially in the age of knowledge workers, it would be prudent for the regulators to devise appropriate metrics to measure the effectiveness of any ICT policy aimed at improving access to education, and to arrange for such data to be regularly collected in order to determine what works and what does not.

The Growth of Open Source in Asia

The Open Source movement has developed a steadily grow-ing mass of fans in Asia, especially in India and China. Run a simple Google search on 'open source India' or 'open source China' and proof of this observation comes in the wealth of material available on the phenomenal growth of Open Source in these countries.

That Open Source has found a large following of believers in Asia is not surprising. Many countries in the region do not have the kinds of per capita incomes and living standards enjoyed in the West. Many governments prefer to save money on licencing fees when they can, particularly as there is afford-able and in many cases free, robust, and good quality software that can essentially perform the same tasks that Windows-based systems can.

With the increasing user-friendliness of the more popular Linux distributions, their adoption rates in Asia are likely to grow. The kind of functionality certain Linux distributions have, the quality of the current crop of Linux kernels, and the program-ming that goes into the distribution are quite remarkable. The PCLinux Operating System (OS), for example, offers among others out-of-box compatibility with Microsoft Word files and Adobe PDFs. The openoffice.org software bundled with the dis-tribution has an in-built capability to convert .doc files to .pdf, as well as the ability to run specific graphical enhancements akin to those available in Windows Vista. Even more remarkable is the fact that the graphical enhancements run perfectly well using an Open Source set of rendering drivers on a machine with a measly 256 MB of Random Access Memory (RAM) and a generic Intel graphics chipset with less than 128 MB of memory, a configuration significantly lower than what is recommended for running Windows Vista.

In software and operating systems that run mission critical servers and data farms, Open Source has likewise been mak-ing steady inroads. The server market in Asia is perhaps the best source of revenue for entities like Novell with its Suse Linux Enterprise Server product, and Red Hat with its Linux distributions for servers.

We believe that, especially in China and India, the move toward greater use of Open Source software in government was prompted at least in part by World Trade Organization com-mitments regarding non-use of pirated software. Open Source poses no real issue with regard to licencing fees and intellectual property restrictions — this despite Microsoft putting itself in an advantageous position in China through a massively coordinated campaign of lobbying and targeted Microsoft development and training actions culminating in President Hu Jintao endorsing Bill Gates as a friend of China and the Chinese people.

In India, the view is equally positive about the future of Open Source. About the only thing holding India back from an explosive growth of the indigenous market for Open Source programs is the lack of coordination among groups of coders and programmers across the sub-continent, and it is only a matter of time before this issue is progressively resolved. This brings us to the following question: Does the growing adoption of Open Source warrant a regulatory response in Asia?

At the moment, we believe that an appropriate policy response ought to be policy and/or regulation focused on:

1. Enhancing the adoption of Open Source systems in de-veloping markets in Asia, as increased adoption of Open Source standards (so long as Intel and Advanced Micro Devices — AMD — keep making chipsets that work with the code) can lower the overall costs of systems used for increasing ICT penetration rates in rural and non-central urban areas;
2. Using Open Source to provide an ideal and affordable platform for the development of local content; and
3. Competition regulation to ensure that entities with significant market power and market share in the software markets in a jurisdiction and their distribution networks in the region will not enter into or promote potentially anti-competitive tying arrangements.

Encouraging the Growth of Localized and Indigenous Digital Content

This section provides an overview of the issues facing develop-ing Asian nations seeking to encourage the migration, avail-ability, and accessibility of local content on the Internet, and suggests policy and regulatory approaches that can accelerate or catalyse this process.

The campaign for more online content could have the following objectives:

1. To increase awareness of the content by making it easily accessible to a larger audience;
2. To strengthen local identities;
3. To reaffirm local identities particularly in the context of a people's diaspora; and
4. To provide local content creators with an increased revenue source via licencing.

Another interesting motivator is that more local content may increase the penetration rate of ICT in developing nations. That is, people may well decide to access the Web more regularly if they know that the content they have grown up with and strongly

identify with, and which is symbolic of their own culture, is available online.

However, increasing local content online faces several challenges. One of these is the ubiquity of English and the resultant gaps in the technology powering the Web. The Internet is no stranger to the laws of supply and demand, and it is those laws that have thus far dictated the major language of the Web — English. Much of the early development and evolution of the Internet took place in the United States, an English-speaking jurisdiction. Moreover, the demand for paid as well as unpaid Web content has been predominantly from an English-speaking audience. In addition, throughout the 1970s to the mid-1980s, the vast demand for information technology hardware and software was from North America and Europe (Japan being the only exception in Asia), which resulted in the vast majority of hardware, firmware, and software being designed with the English speaker and writer in mind.

However, lately the situation has been changing for the better, and while English remains the primary language of the Web, multi-language support has been built into applications powering the Web, content development applications, and browsers (both Internet Explorer and Open Source browsers like Firefox and Opera). These changes have come about again as a consequence of rational economic behaviour. As the multilingual world comes online, the technology they use to communicate, create, collaborate, and interact with must similarly become multilingual. After all they comprise a far larger market than the United States and other English-speaking populations.

Changes at the application and browser levels have come about due to the Unicode Consortium's development and adoption of the Unicode character set, which is capable of assigning unique numbers to up to one million separate characters for a given language or symbol set. Its adoption has resulted in popular Internet browsers having font support for most major world languages. This has also led to the building of hardware that makes it easier to encode in a local language. For instance, a keyboard with the Bhutanese and Tibetan Dzongkha script is now available. The keyboard mapping is based on the Unicode Dzongkha values.

Meanwhile, on the software development front, Microsoft has been publishing and educating developers on building 'world ready' applications that will run in the Windows operating system. Microsoft in fact advocates that 'world ready' applications running in Windows should be fully Unicode-enabled.

Are these steps enough? Arguably not, since at the end of the day, software and Web developers in developed nations are usually English speakers themselves. Consequently, it is only natural that their tendency would be to focus on developing a user interface that, while translatable into numerous languages, may

not necessarily be appropriate to another language or sensitive to other cultural mores and norms.

Therein lies an opportunity for regulators in developing Asian nations to address a need. Arguably, there is an untapped demand for culture, language, and geography-centric user interfaces for various applications. These can layer on top of existing applications and complement the Unicode support that allows the application's original layout and user-viewed instructions to be displayed in a local language. The role of regulators and policymakers is to create an enabling environment for local entities to engage in these processes through a viable business model.

Another challenge that regulators in developing Asian countries need to address is the relatively low Web usage and penetration. A quick review of Internet penetration statistics in developing Asian countries like Bangladesh, Bhutan, Cambodia, India, Laos, Mongolia, and Pakistan reveal that Web penetration in developing Asia lags well behind that in North America and Europe. According to International Telecommunications Union statistics, penetration rates in developing Asian nations can be almost non-existent (e.g. 0.2 percent in Bangladesh), very low (e.g. 3.5 percent in India), and low (e.g. 10 percent in China). Contrast this with penetration rates in developed nations like the European Union (51.9 percent), the Republic of Korea (66.1 percent), and the United States (69.4 percent).

As discussed earlier, increasing the ability of people to communicate online more easily in local languages, and giving them the tools with which to put local content online and create it online, may in fact lead to increased Web penetration. But such a policy ought to be implemented alongside policies that aim to encourage the build up of broadband infrastructure and the growth of Internet service providers via innovative licensing and cost sharing methods.

Indeed, there is scope for innovative regulatory strategies to accelerate the process by which local content can get online or be created online. Here we discuss a two-pronged approach that regulators and policymakers can customize and adopt to encourage the growth of local content online. The essence of this approach is that any set of policies aimed at achieving the increased migration of local content online must address the issue of building demand for local content and making it easier for such content to be supplied. The regulatory skill would lie first in deciding the right policies to address each side of the equation, and second in concertedly and effectively implementing such policies.

Demand side policies aim to increase the exposure of the local content. This can be done by increasing awareness of the content, and by making it more easily accessible. The appropriate licencing model plays a key role here. In addition, there

is the issue of making local content viewable in other languages. This in turn increases the potential market audience for such content. The other facet of demand is increasing local demand via policies encouraging progressive and sustainable deployment of broadband and high-capacity bandwidth infrastructure. Public–private partnerships and innovative financing models in this context are well worth exploring.

Supply side policies cover policies like building localized user interfaces to layer onto applications (discussed earlier). In addition, there could be policies to encourage ventures that can digitize existing content easily, preferably in a form that is digitally modifiable (think MSWord and not Portable Document Format — PDF). This might be by offering subsidies or better tax rates to businesses engaged in the creation or digitization of local content (i.e. favoured tax rates on revenues from digitizing and creating local content). Additionally, consider encouraging research and development in Open Source applications. Open Source software is gaining increased acceptance, and there is a close to zero entry cost barrier (in terms of development licences) for developers who wish to develop software for Open Source platforms. For that matter, if a locally developed application is good enough, there are a number of cross-over programs that can allow it to run on multiple operating systems (although usability remains an issue). Examples of such cross-over programs are Wine and Cross-Over by Codeweavers.

The licencing model to be adopted is very important because it influences both the demand and supply of content. A balance should be struck between incentivizing increased production and development of original local content (via the promise of adequate economic return) and encouraging demand through a licencing model that is, and is perceived to be, fair to users.

Much content today is protected by rather restrictive copyright protection where even fair use often requires permission from content owners. Add to that the digital rights management (DRM) software that arguably extends protection to content beyond the intended scope of copyright and content starts to look more ring-fenced than was perhaps intended by traditional intellectual property rights regimes that allowed for fair use. Unless demand for content far outstrips supply, this may indeed drive people away from such content. Worse, it may lead people to circumvent DRM schemes and simply try and get content for free. Once others get content for free, those who actually want to use it commercially may also decide to go the free route.

Instead of the traditional copyright and DRM models, policymakers in the developing Asian nations can consider adopting suitably modified versions of the Creative Commons (CC)

licencing model. This model differs from the traditional licencing models in the following significant ways:

1. It is free for anyone to use and customize to suit their needs.
2. It allows for a greater degree of flexibility in terms of what can be offered to those who wish to use the content non-commercially and those who wish to use it commercially.
3. It takes what seems to be a more pragmatic approach that is more cognizant of the nature of online use of content.
4. It allows for a content–owner–friendly approach to customization of licences if required.
5. It tends to encourage an 'open to full view and review' approach to content, with revenue derivation encouraged only for cases of commercial use. In this sense it discourages non-porous DRM.

The main Creative Commons licences[9] are as follows:

1. Attribution Non-commercial No Derivative: The work can be copied and shared as long as the author is identified. Permission is required before any derivative work based on this work is created or any commercial use is made of the work.
2. Attribution Non-commercial Share Alike: The work can be copied, remixed, tweaked, and built upon non-commercially. All new work based on the original must also carry the same licence. Permission is required for commercial use.
3. Attribution Non-commercial: This has the same terms as Attribution Non-commercial Share Alike except that derivative works need not be licensed on the same terms as the original work itself.
4. Attribution No Derivatives: Redistribution of the work is allowed for commercial and non-commercial purposes so long as the work is passed on whole and unchanged with due attribution to the content author.
5. Attribution Share Alike: This allows remixing, tweaking, and building upon work for commercial and non-commercial purposes. Attribution is required and new works must carry an identical licence, which means that derivative works would also allow commercial use.
6. Attribution: The only condition is attribution. Any commercial or non-commercial use is allowed.

There are also specialized licences for specific types of content and content owners, as summarized by the following excerpt:

Sampling Licences allow for snippets (not whole work) to be remixed into new works, even commercially.

Our Public Domain Dedication lets you free works from copyright completely, and our Founders Copyright lets you do the same, but after 14 or 28 years. Musicians looking to share their work with fans might want to look at the Music Sharing licence. The Developing Nations licence lets you offer less restrictive terms to countries that aren't considered high income by the World Bank, and finally, for those licensing software, we offer the GNU GPL and GNU LGPL licences. (Creative Commons)

These models can be tweaked to suit the specific circumstances of a developing Asian nation. For instance, works can be offered on Attribution Non-Commercial Share Alike *plus* Developing Nations licence terms, with the Developing Nations terms being offered to commercial users in developing *and* developed nations so as to reach a larger audience and increase the chances for collaborative derivative works.

One might also consider another strategy as follows: once local content online achieves a healthy level of mainstream acceptance, developing Asian nations may consider coordinating their licencing approaches and collectively offering less restrictive licence terms for local content to developed nation users, in exchange for less restrictive terms for access to content from developed nations.

In global knowledge trade today, licence fees are essentially tariffs and licence terms are the conditions of trade. In essence then, this is nothing more than trade block theory applied to knowledge goods and concrete intellectual property.

In sum, we argue that in the era of knowledge goods and knowledge trade, content is the product and the controllers of content are king. In such a world, it is wholly pertinent for developing Asian nations to consider devising strategies and policies to encourage the proliferation of their own local content online as the Internet is the world's unrivalled distribution network for content. Innovative tools exist for the development of local content online. The art lies in determining what will work for a particular nation in terms of improved demand and supply for local content online, and to then constructively and effectively implement those policies at the national and international level.

CONCLUSION

In this chapter, we sought to provide a snapshot of the regulatory approaches being taken in the ICT sector in various jurisdictions in Asia. We focused on the following areas to draw out observations and comparisons between regulatory approaches in developing and developed ICT markets in Asia:

- Key institutions and organizations dealing with ICT
- Key ICT policies, thrusts, and programs
- Citizen-focused e-government services
- ICT policy and improving access to education
- Growth of Open Source software
- Growth of localized digital content and its regulation

Across developed ICT markets, regulators and policymakers are focusing on developing a more inclusive approach to enable larger segments of the population to use ICTs and benefit from them. Indeed, for holistic development of an ICT sector, especially the kind of development that will enable developing ICT markets to compete in an environment marked by rapid technological changes, policies, and regulations that address the demand side of the ICT equation are necessary.

Developing ICT markets in Asia seem to realize this as well, although understandably, the focus in such markets is on state-sponsored build-up of physical ICT infrastructure and the development of indigenous ICT services sectors that have lower personnel and operating costs, while also trying to encourage ICT adoption among the populace.

Whether and to what extent these regulatory approaches lead to the beneficial evolution of ICT markets in Asia remain to be seen. But the recognition of the need for policies that holistically address the demand and supply sides of the ICT equation for the healthy development of competitive ICT markets in Asian jurisdictions is certainly encouraging.

NOTES

1. Unless otherwise indicated, information on key organizations and institutions dealing with ICTs in the jurisdictions mentioned in this section of the chapter is taken from the chapters on individual economies in this edition of the *Digital Review of Asia Pacific*.

2. See, for instance, TMC News (2007) at http://asia.tmcnet.com/news/2007/11/27/3123957.htm

3. Unless otherwise indicated, information on key ICT policies, thrusts, and programs in the jurisdictions mentioned in this section of the chapter is taken from the chapters on individual economies in this edition of the *Digital Review of Asia Pacific*.

4. For instance, Bhatnagar (2004, p. 19) defines e-government as 'the use of ICT to promote more efficient and cost-effective government, facilitate more convenient government services, allow greater public access to information, and make government more accountable to citizens'.

5. Unfortunately, we are limited to expressing this hypothesis based on our observations and experiences in Asia, since we are not aware of any studies to test this.

6. As is evident, for instance, by examining the range of government services available via Singapore primary e-government portal, www.gov.sg, and browsing through the services available under the 'Citizens & Residents', 'Business', and 'Non-Residents' tabs at the site.

7. See, for example, Infocomm Development Authority of Singapore (2007b) at http://www.igov.sg/NR/rdonlyres/C8F242DE-6C0D-4D40-A7A7-D94B7D2F6A09/19110/SOE_factsheet_Oct2007.pdf

8. e-Ink technology, which currently provides the closest approximation to paper, is still in its infancy in terms of worthwhile commercial applications.

9. Full descriptions of these licences, including 'plain English' and legal texts of the licences, are available at http://creativecommons.org/licence/ and http://creativecommons.org/about/licences/meet-the-licences

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Managing innovation in the network economy: Lessons for countries in the Asia Pacific region

Mahendhiran **Nair** and Tengku Mohd Azzman **Shariffadeen**

INTRODUCTION

The information or knowledge revolution has been under intense scrutiny and debate for several decades now. The spectacular rise of the Internet and the Web is the major reason for this wide interest. And yet, while information and knowledge are as important as the Internet if not more so, they often take a back seat in the debate. Their abstract and diffuse nature has made them less amenable to quantitative analysis, rendering the information and knowledge discourse largely descriptive, anecdotal, and qualitative. Orbicom was one of the pioneering organizations to make the connection between the digital and knowledge revolutions and to do it in a quantitative manner (Sciadas 2005). In its 'monitoring the digital divide' initiative, it formulated a fresh way of measuring the digital divide based on the *infostate* of a country, which results from the combination of its *infodensity* and its *infuse*.

In a similar spirit, this chapter presents a quantitative method of assessing the innovative capacity of countries. It is proposed as a framework enabling a more detailed analysis of what makes a country innovative, which in turn would make possible the setting of goals that would serve as guideposts on a country's journey toward greater innovativeness, productivity, and competitiveness. Such an analytic approach would help policymakers and government leaders manage the process of knowledge-based development to enhance the quality of life and well-being of a country's citizens.

In the last three decades, the Asia Pacific region has been one of the most dynamic in terms of socio-economic development. Many of the countries in the region were underdeveloped when they achieved independence in the 1940s–1960s. World War II decimated many of these economies, with conditions worsening further as a result of post-war regional conflicts. However, despite a bleak past, many of these countries were able to transform their economies into leading producers of automobiles, electronics, and other consumer durables. These transformations were made possible first by the adoption of industrialization, and lately, by the adoption of new technologies, including information and communication technologies (ICTs).

Still, although there has been significant socio-economic development in the region, many countries remain 'under-developed'. Some studies have shown that the widening ICT gap is a significant contributor to the increasing wealth gap between developed and other countries in the Asia Pacific region (cf. Nair et al. 2005; Sciadas 2005). The role of ICT in enhancing competitiveness and sustainable development has been widely debated in the literature. Studies by Gurbaxani et al. (1998), De Gregorio (2002), and Criscuolo and Waldron (2003) show that ICT has increased the productivity, efficiency, and market reach of firms all over the world. On the other hand, Lau and Tokutsu (1992), Kraemer and Dedrick (1993), and Kim (2003) argue that investment in ICT infrastructure alone is not sufficient for economies to achieve sustainable development, and that a skilled workforce is an important precondition for nations to benefit from ICT investments. This is supported by the infostate conceptual framework, where infodensity refers to the ICT capital and ICT labour stocks that complement info-use, which refers to the usage flows of ICT. In other words, a causal relationship between investments in human capital and infrastructure development on one hand, and the information and knowledge flows engendered by them on the other, produces higher levels of economic performance.

Realizing the potential of ICT in enhancing economic prosperity, Asia Pacific countries have increased investment in ICT over the past decade. The World Information Technology and Services Alliance (WITSA) predicts that the Asia Pacific region will outstrip other regions in ICT spending, with a compounded annual growth in ICT spending of 11.1 percent from 2005 to 2009 (WITSA 2006). However, it remains unclear whether ICT investment has helped countries in the region close the innovation gap with more evolved economies. While there is evidence that ICT does contribute significantly to socioeconomic development, there is uncertainty about how this comes about and how it may be improved.

This chapter aims to empirically examine the linkage between ICT development and innovative capacity in Asia Pacific countries. More specifically, it looks at the gaps in ICT and innovative capacity between developed and other countries in the Asia Pacific region, and outlines measures to close the digital and innovation divides between countries. The chapter is organized as follows: a brief review of the network economy is provided, followed by an explanation of the proposed theoretical framework and empirical method to measure the national innovation ecosystem (NIE). The empirical results are then presented and discussed, followed by strategies for enhancing the NIE in the Asia Pacific region. The final section proposes a way forward.

REVISITING THE NETWORK ECONOMY

The network economy is also sometimes referred to as the information economy, virtual economy, digital economy, or electronic economy. The wide variety of 'network effects' manifesting the digitization of information contributes to socio-economic development via two channels. First, the digital medium has resulted in the emergence of new sectors related to software, hardware, systems, and ICT-related services. For some countries, these new economic sectors provide opportunities for higher value added products, and thereby, a more competitive and productive economy. Second, the interactive digital environment has opened up new dimensions for communication, commerce, trade, knowledge gathering, and technology transfer. This aspect of the network economy can be enjoyed by all countries, regardless of whether they aspire to develop an ICT economic sector. The only condition is that they learn to effectively apply ICT to all important economic sectors across the board. Since this enabling function of ICT is of great interest to most countries, we provide several developmental examples.

The digital medium facilitates communication and faster exchange of information between suppliers and consumers of goods and services. Multiple sourcing from the global markets allows firms to reduce their cost and diversify their market risks. Consumers are also able to use 'shopbots' (also known as 'shop robots') to quickly search for information on products and services at a relatively low cost. The new multimedia and computing technologies likewise allow firms to track and study changing global market trends, which in turn enables them to produce a wider range of products that meet the needs of diverse markets. For example, the LEGO Group (http://www.lego.com) uses the digital medium to identify changing market demand by providing various incentives for its customers to provide feedback on improving product designs. By such means network-savvy firms like the LEGO Group are able to pursue *economies of scope*.

In the network economy, the production of goods and services transcends the limitations of traditional factors of production, namely, land, labour, and capital. In the traditional economy, nations with large endowments of land, labour, and capital were in a better position to lead the innovation and competitiveness race. However, in the network economy, national competitiveness is a function of the level of connectivity to the global economy. Nations with a small land mass are able to move from 'place' (land), which is limited, to 'space' (cyberspace), which is unlimited. The relaxation of physical constraints has helped small nations to catch up with more developed countries.

In the digital space, there is also greater cooperation among buyers. This is changing how goods and services are produced and traded in global markets. For example, new technology like Skype (http://www.skype.com) pools unused and spare computing power to allow people to make free calls over the Internet. The cost of communication is significantly reduced — reportedly by as much as 90 percent (Hof 2005) — through the sharing of a resource (unused computer space). The increased cooperation among consumers facilitated by the ICT revolution has led to positive network externalities. The Web provides a platform for consumers to meet, share information, and exchange knowledge (e.g. ratings) about goods and services. Thus, 'cooperative consumer activism' spurred by the network revolution can determine the successful expansion of a firm's market reach. These firms provide a significant boost to the competitiveness and global presence of their host country.

The digital medium also plays a major role in fostering greater cooperation among firms, related organizations, and consumers. In the network economy, organizations are better able to tap into the 'collective intelligence' of consumers, suppliers, and other stakeholders. Instead of having a few researchers working

to develop a new innovation, firms can take advantage of the 'network brain' that is made up of millions of people working on similar projects. For example, Procter & Gamble (P&G) with a research budget of USD 1.7 billion uses a network of 80,000 independent researchers from 173 countries to collectively solve research problems (Hof 2005). P&G's investment in the network brain has increased product development from outside the organization 20–35 percent (Hof 2005). There are thousands of enterprises like P&G that use network technologies to locate solutions and innovations outside their firms. Thus, the ICT revolution has enabled 'open innovation' on a grand scale.

Several empirical studies show that firms that have invested in ICT infrastructure and human capital development have benefited in terms of increased productivity and efficiency. For example, Baily (2002) found that greater use of ICT increased multi-factor productivity in the service sector in the United States (US) in the 1990s. Kumar (2002) concluded that investments in ICT and education contributed to economic growth in the US from 1964 to 2000. Becchetti et al. (2003) showed that ICT investments had a positive impact on the productivity and efficiency of small and medium-sized enterprises (SMEs) in Italy from 1995 to 1997. They also showed that telecommunications investment increased the development of new products and processes, while software investment increased the demand for skilled workers and improved labour productivity. A more recent study by Timmer and van Ark (2005) indicated that ICT contributed to the growth of labour productivity in the European Union (EU) and the US through ICT-capital deepening and total factor productivity growth due to the production of ICT goods. The study found that these two channels are responsible for labour productivity in the US surpassing labour productivity in the EU from 1995 to 2001.

In sum, the digital revolution has powered greater interdependence and interconnection between markets, economic agents, and nations. The so-called 'network effects' of the digital revolution have produced a critical mass of ICT users, with each user able to benefit from the shared information and knowledge made available by other users connected to the system. The enhanced convergence of new technologies and the development of highly integrated systems is blurring the boundaries between the different economic sectors and the roles of economic agents. Nations and enterprises that have learned to play by the 'new rules' of the network economy are in a better position to enhance innovative capacity and achieve sustainable socio-economic development.

In the next section, we apply this qualitative understanding of the dynamics of the network economy to derive an analytic framework for measuring innovative capacity that can be used for quantitative analysis.

MEASURING INNOVATIVE CAPACITY IN THE NETWORK ECONOMY

Joseph Schumpeter popularized the term 'creative destruction' for innovative capitalist products and methods that will continually displace old ones. Schumpeter (1934, 1942) gave numerous examples to illustrate the point, from factories wiping out blacksmith shops to automobiles replacing buggies and horses. In more recent times, the concept of creative destruction captures the underlying structural changes taking place in the knowledge-based economy whereby traditional corporations are being replaced by virtual teams and network-based organizations. Smaller nations and firms are demonstrating that they are equally capable of tapping into global markets to gain competitive advantage.

Here we present an analytic framework for examining the underlying structure of the network economy. We discuss the enabling environment that contributes to the innovative capacity of nations, and describe an empirical method to measure the 'building blocks' of the NIE and their contribution to the innovative capacity of nations. The empirical analysis also benchmarks NIE developments in Asia Pacific and other regions.

Framing the Innovation Challenge: Moving from Description to Measurement

In the industrial economy based on the manufacture of physical goods, larger economies such as Japan, Germany, the UK, and the US were the dominant players. However, with the rise of the network economy, smaller nations such as Finland, Hong Kong, Ireland, Singapore, and Taiwan have shown their ability to rapidly enhance their competitiveness, and in some sectors of the economy, these smaller economies have surpassed the traditional economic superpowers. Much of their success is attributed to investment in 'creative capital' and the development of a resilient NIE that continuously adapts to global technological changes.

Several studies show that innovation is an important source of socio-economic development. Romer (1986, 1990) has argued that technology coupled with human capital development and research and development (R&D) are important sources of economic growth. Lucas (1988) has shown that economic disparities between countries are a function of varying levels of stock of human capital to undertake innovative activities, with developed economies being more competitive in attracting the best knowledge workers from other countries, especially from

underdeveloped economies. The 'brain drain' from under-developed economies undermines their innovative capacity and hinders sustained socio-economic development in these countries.

A number of economists have been critical of the traditional economic models that attempt to explain the different innovation levels of countries. They argue that such models fail to capture the enabling institutional framework for sustaining innovation. Among the pioneering works that attempt to capture the role of institutions in innovation are those by Nelson and Winter (1977) and Nelson (1981). Building on their ideas is the concept of national system of innovation, the key studies of which include those by Freeman (1987), Dosi et al. (1988), Lundvall (1992), Nelson (1993), and Edquist (1997).

In the national system of innovation literature, two schools of thought have emerged. The first school is led by Nelson (1993), who argued that the national system of innovation is centred on the institutions that coordinate and enable innovation in a country, including institutions that are responsible for rules and regulations. Nelson (1993, p. 4) defines the national system of innovation as a 'set of institutions whose interactions determine the innovative performance of a nation's firms'. The second school is led by Lundvall (1992), whose primary argument is focused on 'learning-by-doing' and 'learning-by-using'. Lundvall (1992, p. 2) describes the national system of innovation as 'constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge'. Lundvall's work contributed to the concept of the 'knowledge economy' (Godin 2006).

More recent studies have attempted to measure underlying factors that impact upon the innovative capacity of a country, which is defined by Furman et al. (2002, p. 900) as 'the ability of a country — as both political and economic entity — to produce and commercialize a flow of new-to-the-world technologies over the long term'. They argue that national innovative capacity is a function of three factors, namely (i) innovation infrastructure; (ii) the industrial cluster environment; and (iii) the linkage between (i) and (ii). Innovation infrastructure is defined as key investments and policies that support innovation. These include investment in human capital development, financial support for science and technology development, and policies and regulations that promote research and commercialization. The 'cluster-specific environment', the second factor, is defined as the geographical locations of interconnected firms based on the Porter Diamond Model (Porter 1990) where the competitiveness of the clusters is dependent on the following drivers: the intensity of rivalry in the local market, demand conditions, the presence of local supporting industries, and the availability of high quality factor inputs.

Although Furman, Porter, and Stern's model (2002) captures the key drivers of national innovative capacity, it is not without limitations. One of these is that the three pillars of innovation are too broad, and thus are unable to capture the impact of technological infrastructure (especially ICT) on other key drivers such as human capital, regulations, institutions, and interactions between the key stakeholders in the system.

To overcome this limitation, Nair (2007) has proposed a model that measures the impact of ICT on the quantity and quality of human capital, strategic linkages, good governance, incentive systems, and institutions — all key pillars of the NIE. Nair (2007) argues that a nation's innovation capacity is dependent on the level of development of the NIE, which in the network economy is characterized by two important building blocks called the *foundation* and *driver* conditions.

The foundation condition captures the infrastructure that connects people to the global economy. Connectivity to the global economy contributes to economic development through two important channels. First, infrastructure spending, especially in ICT, can lead to economic growth through the production of ICT products and services. Second, ICT infrastructure investment has several spillover benefits to society, among these the creation of virtual communities leading to new generation products and services; increased global reach of enterprises; and ability to attract multiple sources of production inputs at a relatively low cost. These spillover benefits allow firms to simultaneously pursue *economies of scale* and *economies of scope*, both of which are important for achieving competitive and comparative advantage. It is arguable that these spillover effects are more important to most countries as they lead to higher levels of productivity and competitiveness in all economic sectors, and are not limited to the ICT sector alone.

The foundation condition is a necessary condition for sustained socio-economic development in the network economy. But it is not sufficient to stimulate innovation and economic development. A second set of conditions, called the driver condition, works in combination with the foundation condition to create an enabling environment to stimulate economic growth. The driver condition encompasses five factors that are vital for nations to move up the innovation value chain:

- Intellectual capital development, including the ability to increase the supply of a skilled workforce and sustain them in the economy.
- Interaction between stakeholders in the economy, especially between research institutions and enterprises, and between enterprises.
- Integrity and good governance (including adherence to best practices and global standards and benchmarks).

- Incentives to stimulate creativity and innovation, including fiscal and non-fiscal incentive policies that will encourage foreign enterprises to bring in high-technology investment and new know-how and encourage local enterprises to adopt new technologies and engage in R&D activities.
- Institutions for the effective operation of the network economy, including legal and regulatory institutions.

Figure 3.1 shows how the foundation condition and the driver condition together impact innovative capacity. A highly innovative country is able to create more value, and thus becomes more productive and competitive, which leads to greater opportunities for wealth creation and a higher standard of living. Greater wealth produces surplus income that may be reinvested to further improve the foundation and driver conditions, thereby closing the feedback loop. A well-managed innovative economy then becomes a mutually supporting system that produces sustained and accelerated growth.

The foundation condition contributes to innovative capacity in two distinct ways. First, it directly enhances the reach of all economic agents in the economy, which is an important feature of the network economy as discussed earlier. Second, the foundation condition operates in tandem with the driver condition to magnify the impact of the driver condition on innovative capacity.

The wide range of factors that influence innovative capacity as reported in the literature shows that the underlying structure of the economy is highly complex, characterized by interaction between and among many key institutions and stakeholders in the system. The inter-relationships between these institutions and stakeholders are the primary drivers and catalysts of the production, diffusion, and use of knowledge in the new economy. Key building blocks of the NIE were identified through detailed literature review, and these have been incorporated into the new innovation system framework presented here.

The proposed framework provides a holistic model of a complex system that makes it possible to analyze innovative capacity empirically and quantitatively. In the following section, we empirically examine the impact of the foundation and driver conditions on the innovative capacity of developed

Figure 3.1
The 'building blocks' of the new economy
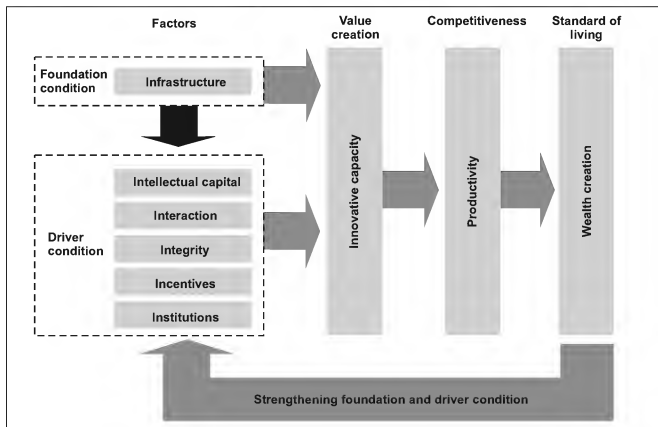
(Source: Nair 2007)

and developing countries in Asia Pacific and other regions. In particular, the empirical models will assess whether a highly developed foundation condition is an important requirement for enhancing the impact of the driver condition on the innovative capacity of countries, both developed and developing.

Measuring the Impact of the Foundation and Driver Conditions on Innovative Capacity

Five empirical models are presented to measure the impact of foundation and driver conditions on innovation in Asia Pacific countries and in countries located elsewhere. Details of the models are provided in Appendix 3.1A to avoid technical complexity in the main presentation.

Model 1 seeks to answer the following questions:

- What is the impact of *foundation* and *driver* conditions on the *innovative capacity* of countries?
- Do the foundation and driver conditions *complement* each other, and if so, how?

In other words, the model should enable us to say whether the framework formulated is a useful measure of innovative capacity to begin with. It also allows us to show whether the foundation condition is an important 'precondition' for enhancing the contribution of the driver condition on innovative capacity.

The next four models compare the innovative capacity of selected developed and developing countries. Four groups of countries are considered:

1. Developed countries in Asia Pacific
2. Developing countries in Asia Pacific
3. Developed countries in other regions
4. Developing countries in other regions.

Model 2 seeks to answer the following questions:

- Is *innovative capacity* different in the four groupings of countries?
- How significant are these differences?

A comparison of innovative capacity among the four groups of countries will show the relative positions of each, as well as the significant differences between these country groupings, if any.

Model 3 seeks to answer the following questions:

- Is the contribution of the *foundation* condition to *innovative capacity* in the four groupings of countries different?
- How significant are the differences?

Model 4 seeks to answer the following questions:

- Is the contribution of the *driver* condition to *innovative capacity* different in the four groupings of countries?
- How significant is the difference?

Model 5 seeks to answer the following questions:

- Are the *complementary effects* of the *foundation* and *driver* conditions different in the four groupings of countries?
- How significant are the differences?

Data for the countries included in this study (listed in Table 3B.2, Appendix 3.1B) were obtained from the *Global Competitiveness Report* for three sample periods: 2001–2002, 2002–2003, and 2004–2005. A detailed discussion of the variables used in the study and the data sources is given in Table 3B.1 (Appendix 3.1B). Internet penetration rates were used as a proxy for the foundation condition. The driver condition was taken as the average of the variables measuring intellectual capital, interaction, integrity, incentives, and institutions. All of the variables used were converted to base 100 so that they can be formed as a composite index.

EMPIRICAL RESULTS

In this section, we discuss the empirical results obtained from the application of the five models. Figure 3.2 is the scatter plot for the foundation and driver conditions for 104 countries for the period 2004–2005. It shows that there is a positive correlation between foundation and driver conditions. This suggests that for these 104 countries there is a strong relationship between foundation and driver conditions.

Figure 3.3 is the scatter plot for the foundation condition against innovative capacity. The plot shows that as the foundation condition improves, the innovation capacity of countries increases.

Figure 3.4 is the scatter plot for the driver condition against innovative capacity. It shows that as nations improve their driver condition, their innovative capacity also improves. From Figure 3.3 to Figure 3.4, we observe that the driver condition has a greater explanatory power for innovation than the foundation condition. Both plots confirm that the foundation and driver conditions greatly influence innovative capacity and thus provide an effective means of measuring the NIE.

The estimated results for Models 1 to 5 are reported in Table 3B.3 (in Appendix 3.1B). Pair-wise comparisons between the coefficients in the models are reported in Table 3B.4. The key findings for the different models are thus summarized.

Figure 3.2
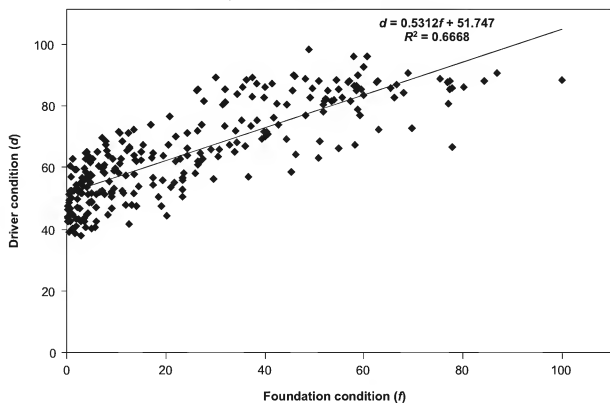Scatter plot of the foundation and driver condition

$d = 0.5312f + 51.747$
$R^2 = 0.6668$

Figure 3.3
Scatter plot of the foundation condition and innovative capacity

$y = 0.5349f + 43.515$
$R^2 = 0.5271$
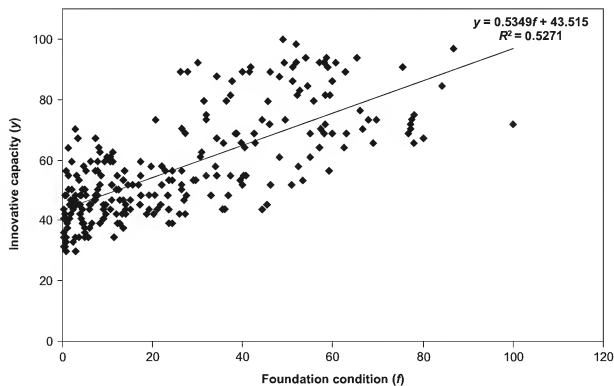
Figure 3.4
Scatter plot of driver condition and innovative capacity

$y = 0.9506d - 4.9868$
$R^2 = 0.7029$
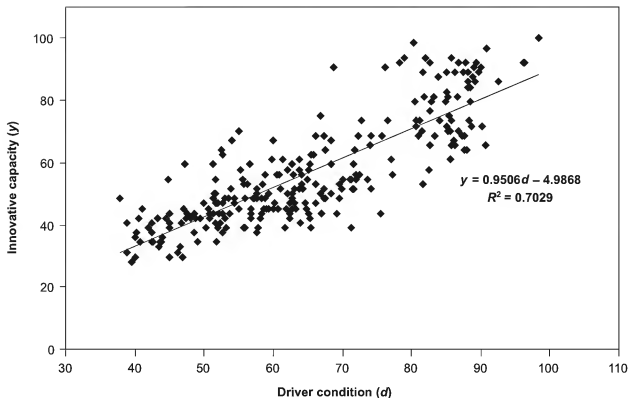
The estimated results for Model 1 suggest the following:

- The foundation condition alone is not sufficient to raise the innovative capacity of nations.
- The driver condition is necessary to raise the innovative capacity of nations.
- Connectivity to the global economy via the Internet (the foundation condition) enhances the impact of the driver condition on the innovative capacity of nations, which demonstrates that the foundation condition is indeed a precondition for improving innovative capacity.

The empirical results for Model 2 were similar to those for Model 1. In particular, they support the following observations:

- The innovative capacity of developed countries in the Asia Pacific region is similar to that of developed countries in other regions.
- The innovative capacity of developed countries in the other regions is significantly higher than that of developing countries.

- The innovative capacity of developing countries in the Asia Pacific region is significantly higher than that of developing countries from other regions.

The empirical results for Model 3 suggest the following:

- The impact of the foundation condition on innovative capacity in developed countries in Asia Pacific and other regions is similar.
- The impact of the foundation condition on innovative capacity in developed countries is higher than that in developing countries.
- The impact of the foundation condition on innovative capacity in developing countries in the Asia Pacific region is similar to that in developing countries in the other regions.

The empirical results for Model 4 suggest the following:

- The impact of the driver condition on innovative capacity in developed countries in the Asia Pacific region is lower than that in developed countries in the other regions.
- The impact of the driver condition on innovation in developed and developing countries in the Asia Pacific region is similar.

- The impact of the driver condition on innovative capacity in developing countries in the Asia Pacific region is higher than that in developing countries in other regions.

The empirical results for Model 5 indicate the following:

- The impact of the foundation condition on enhancing the contribution of the driver condition to innovation in developed countries is higher than that in developing countries.
- The impact of the foundation condition on enhancing the contribution of the driver condition to innovation is similar in developed countries in both the Asia Pacific region and other regions.

In summary, the empirical analysis consistently shows that the contribution of the foundation and driver conditions to innovative capacity is higher in developed countries than in developing countries. This is to be expected, as innovation capacity tends to increase rapidly when institutions are in place to stimulate greater interaction and flow of information among all stakeholders in the economy. Further, the level of contribution of the foundation and driver conditions to innovative capacity in developed countries in the Asia Pacific region is similar to that in developed countries in other regions. Likewise, the contribution of the foundation and driver conditions to innovative capacity in developing countries in the Asia Pacific region is similar to that in developing countries in other regions.

The empirical analysis also suggests that a highly developed foundation condition is an important precondition for enhancing the contribution of the driver condition to innovation. It is not surprising that the developed countries are ahead of developing countries in the development of the foundation condition. This enables them to extract greater value from the driver condition, which is also higher, and ultimately become more innovative.

LESSONS FOR ASIA PACIFIC COUNTRIES AND POLICY IMPLICATIONS

The empirical results obtained using the new analytic framework suggests that the innovative capacity of countries in the Asia Pacific region varies according to the level of development of the NIE (i.e. the foundation and driver conditions). Most developed countries in the region have highly developed foundation and driver conditions, comparable to that found in other developed countries. Thus, they are as innovative and competitive as their counterparts in other regions. Further, the different levels of innovative capacity and competitiveness achieved by developed

and developing countries in the Asia Pacific region can also be attributed to the varying levels of development of the building blocks of the NIE.

This analysis suggests that lower levels of development of the NIE in developing countries in the Asia Pacific region may be attributed to weak foundation and driver conditions. A weak foundation condition is due to the following:

- ICT services cost more and are of poorer quality in developing countries than in developed countries due to the highly concentrated market structure in developing countries.
- There is a lack of coordination in planning and in the implementation of ICT infrastructure development plans.

On the other hand, a weak driver condition is due to the following:

- The pool of skilled workers, especially technology-savvy workers, is smaller in developing countries due to a relatively weak education system and a serious 'brain drain' problem.
- Interactions among key stakeholders, such as government, the private sector, educational institutions, and social networks, are uncoordinated and patchy due to weak communication channels.
- The lack of transparent processes and systems, which leads to corrupt practices.
- Fiscal (grants, subsidies, scientific and technological infrastructure funding) and non-fiscal incentives (tax systems) to support R&D, patenting, and commercialization are not in place or not effectively implemented.
- There is no adequate legal and legislative architecture to support the development of a network-based and knowledge-intensive society. This includes lack of legislation or enforcement of intellectual property rights protection and shareholder protection, and lack of laws against corrupt practices and crimes related to the network economy.

Each of these is enough to cause serious problems for developing countries. But in combination their potential negative impact is far worse. Our empirical analysis based on the framework proposed shows that interaction between factors is a characteristic feature of the network economy. Thus, the framework could help clarify issues and challenges for policymakers seeking to manage their respective NIEs more effectively.

A weak foundation condition (ICT infrastructure) will not only limit the opportunities for people to acquire affordable and quality education and learning, but also hinder strategic linkages between all stakeholders in the economy (especially

between government, industry, and enterprises); restrict the ability of firms to access cheaper resources (production materials, technology, human capital, and financing) from global markets; and reduce the opportunities to improve institutions and governance systems. To break away from the vicious cycle of a weak NIE and poor socio-economic development, developing countries in the region should simultaneously improve their foundation and driver conditions.

We now turn our attention to strategies to enhance the effectiveness of the NIE in the region.

An important feature of the NIE is the foundation condition that facilitates connectivity to the global economy. Developing countries in the Asia Pacific region should formulate a clear and coherent plan for developing their ICT infrastructure. The plan should address the digital divide within the countries and identify cost-effective measures to connect people to the global economy. This includes using 'last-mile' and satellite technologies. Such a plan should also raise awareness of effective use of ICT population. Tax incentives should be offered to encourage greater ownership of computers in homes and by SMEs (see 'Internet Connectivity in the Republic of Korea').

To increase the innovative capacity of countries in the region, equal emphasis should be given to raising the quality of the driver conditions. This entails increasing investments in education, especially in ICT in addition to science and technology. Schools in both rural and urban areas should be equipped with ICT, and school curricula should include the use of ICT in teaching and learning. Teachers should be trained in creative learner-centred ICT-supported pedagogies and encouraged to develop content in the local languages. Moreover, curriculum planning and development should involve industry to ensure that curricula are relevant for the formation of a competitive economy. To strengthen the teaching-learning-research nexus, the private sector should be encouraged to invest in human capital development and R&D programs (e.g. doctoral courses). The human capacity-building efforts of schools may be complemented by ICT training programs for the general public offered through publicly funded ICT telecentres (see 'Creative Learning Environment and the Content Industry in Finland').

The level of cooperation between government, universities, and enterprises is dependent on the level of transparency and effectiveness of the public sector in providing efficient and unbiased services. Effective implementation of ICT systems, such as in e-government, can improve access to information; the ability to bypass various levels of intermediaries, thus cutting transaction costs; and the participation of key stakeholders in public policy discussions. Former President of India, Abdul Kalam, aptly describes the key attributes of an e-government system that can instil greater respect for the public sector

as 'transparent smart e-governance with seamless access, secure and authentic flow of information crossing the inter-departmental barrier and providing a fair and unbiased service to the citizens' (Kalam 2003). Greater transparency and good governance is urgently needed to ensure that the Asia Pacific region remains an attractive location for investors. Governments in the region should hasten the implementation of e-government and e-governance initiatives, and benchmark these initiatives to global best practices.

At the same time, an appropriate legal and regulatory framework for the protection of users of the digital medium, especially from high-priced but poor quality service arising from a monopolistic or oligopolistic market structure, should be in place.

Moreover, national policies to enhance innovation need to be better coordinated, for example, through the establishment of a coordinating council at the highest level of government, with membership coming from the public and private sectors as well as from civil society. This has been successfully implemented in some countries in the Asia Pacific and other regions.

Finally, developed countries could play an important role in helping developing countries to create a sustainable NIE and e-commerce environment. This is so not only because developing countries are confronted with competing demands for limited resources and thus find it difficult to provide basic ICT infrastructure and services, but also, and more importantly, because the global community stands to reap huge benefits from greater connectivity and interaction between all countries and their citizens.

THE WAY FORWARD

This chapter has sought to move beyond description to an empirical measurement and analysis of the innovative capacity of countries based on foundation and driver conditions. Decision-makers in the public and private sectors could apply this framework to gauge its value in addressing the challenges of the network economy.

The empirical analysis shows that developed countries in the Asia Pacific region are as innovative as other developed countries. This is largely due to the rapid diffusion of ICT coupled with a high investment in human capital development; institutional reforms; competitive incentives systems; adherence to global standards; and strong linkages between enterprises, government, and educational institutions.

While several countries in the Asia Pacific have a well developed NIE, many other countries in the region have a weak or practically non-existent NIE. A combination of weak foundation

Internet Connectivity in the Republic of Korea

Internet penetration in the Republic of Korea has increased more rapidly than in most other countries (Figure 3.5). The number of Korean citizens with Internet access jumped from 68.3 per 1,000 persons in 1997 to 656.8 per 1,000 persons in 2004, with the largest increase taking place in 1998 (237.7 per 1,000). Most of those with Internet access now use broadband.

Figure 3.5
Korea's Internet penetration rate vis-à-vis other selected countries

(Source: http://earthtrends.wri.org/selectaction.php?theme=1)
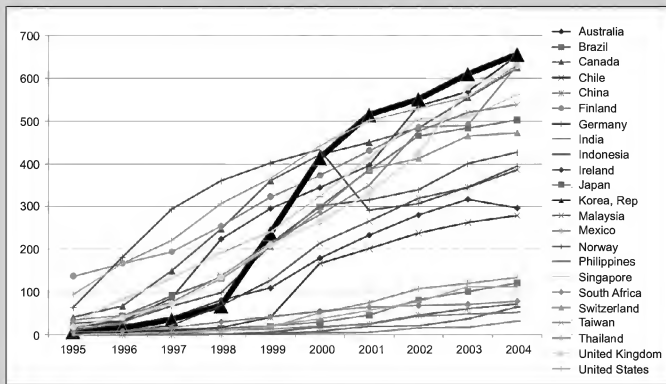
This rapid increase can be attributed to five reasons. First, in 1998, an alternate mode of accessing the Internet was introduced in Korea, namely, via cable television, which was widely available. Second, the government launched the *Korea Information Infrastructure Project* to connect 144 cities across the country to the fast Internet services using optical cable networks. Third, the government deregulated the Internet broadband market, resulting in more service providers in the market. This lowered the Internet subscription rate and increased the quality of services. Fourth, the number of 'PC-bangs' (PC rooms) increased significantly, with close to 16,000 PC bangs established in 2000 to complement government efforts to increase Internet use (Whinston and Choi 2002). Fifth, the government recognized that the education system required a major overhaul to make it more relevant to the new economy and to increase the number of ICT-savvy citizens. The government connected all schools to the Internet. In 2001, compulsory computer education was introduced from first grade of elementary school, and computer use was required for more than 10 percent of the school curriculum (Im 2002). In addition, the Korean Education Network (KREN) was established in the early 1990s to provide high speed access to all public and private universities. In mid-2000 the government introduced the *Ten Million People Internet Education Project* to provide ICT training for people who were not ICT literate.

Korea's innovative capacity improved dramatically with the development of access infrastructure and the expansion of information use.

Coupling a Creative Learning Environment and the Content Industry in Finland

Finland's education system is recognized as one of the best in the world. The Programme for International Student Assessment (PISA) conducted in 2003 by the Organisation of Economic Co-operation and Development (OECD) showed that 15-year-old Finnish students were the top performers in literacy, mathematics, science, and problem solving.

ICT has been a cornerstone of Finnish educational enhancement, fostering independent learning and allowing students to acquire knowledge through networked communities across the globe. Young people in Finland today regard social networking software (the Internet, wikis, and blogs) and sharing technologies as important media for learning. They also recognize the importance of continuous and lifelong learning where knowledge is acquired not only in a formal setting, such as in schools and colleges, but also outside of the school system and throughout the lifespan (Figure 3.6). This learning model requires a living environment that facilitates learning.

Thus, as early as 1996, Finland's National Board of Education began implementing an ICT program to connect schools with information networks, train teachers in pedagogies suited to a digital environment, and develop ICT-enhanced teaching and learning materials. The ICT rollout in Finnish schools emphasized the following: collaborative teaching and learning environments; networking and teamwork, which are critical for promoting universal learning; multidisciplinary learning and research; and enhancing innovation among the younger generation. This program also led to the development of online education materials in the Finnish language, which met the government's objective of creating a new content and new media industry.

Figure 3.6
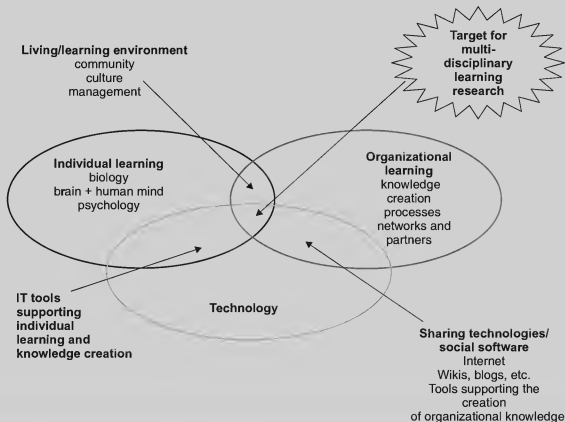
(Source: Academy of Academy of Finland and TEKES 2006)

and driver conditions in these countries gives rise to economies that are dependent on resource-based sectors for socio-economic development. Due to the low utilization of technology, many of these sectors are not globally competitive. For such countries, the analytic framework proposed in this chapter should indicate critical areas for improvement, especially those that will produce the greatest dividends.

Weak foundation and driver conditions will not only hinder innovation, but also limit these countries' adaptability to major structural changes occurring in the global economy. To break away from the vicious cycle of socio-economic instability, developing countries in the Asia Pacific region must accelerate the development of the foundation and driver conditions and ensure that their 'blueprints' for innovation-based development are resilient to global technological and socio-economic tsunamis. Some strategies to strengthen the NIE of countries in the region have been presented. They may be able to stimulate further discussion toward the formulation of more specific policy options, directions, and recommendations.

This study is not without its limitations. One of these is the availability of quality data for developing countries, especially in the Asia Pacific region. Greater attention should be given to improving data collection mechanisms in this region and elsewhere. Up-to-date and accurate information, along with a longer span of the data series, will provide a more robust analysis about the relationships between each of the building-blocks of the NIE (infrastructure, intellectual capital, interaction, integrity, incentives, and institutions) and the innovative capacity of countries in the region. The short- and long-term dynamics between the building-blocks and innovative capacity can be modeled using more robust statistical methods such as panel data econometrics techniques.

Apart from improved data, we encourage more research in this area to enable the construction of more robust frameworks for measuring the innovation capacity of countries. This in turn would provide policymakers and planners with a sound empirical basis for managing their respective economies to achieve greater innovation, productivity, and competitiveness.

APPENDIX

Appendix 3.1A

Technical notes for the empirical models

The impact of foundation and driver condition on the innovative capacity of countries was estimated using the following model:

Model 1:

$$y_i = \beta_0 + \beta_1 f_i + \beta_2 d_i + \beta_3 (f_i \times d_i) + \theta_1 T_{03} + \theta_2 T_{05} + \varepsilon_i$$

where y_i is the innovative capacity of country i. The foundation and driver conditions for country i are denoted as f_i and d_i respectively. The time dummy variables for the period 2002–2003 and 2004–2005 are given as T_{03} and T_{05}, respectively. The residuals are denoted as ε_i, and are assumed to be normally distributed with mean 0 and variance σ^2. The other models estimated are discussed below.

Model 2:

$$y_i = \beta_0 + \beta_1 f_i + \beta_2 d_i + \beta_3 (f_i \times d_i) + \psi_1 DA_{1i} + \psi_2 DA_{2i} + \psi_3 DO_i + \theta_1 T_{03} + \theta_2 T_{05} + \varepsilon_i$$

Model 3:

$$y_i = \beta_0 + \beta_1 f_i + \beta_2 d_i + \beta_3 (f_i \times d_i) + \delta_1 (f_i \times DA_{1i}) + \delta_2 (f_i \times DA_{2i}) + \delta_3 (f_i \times DO_i) + \theta_1 T_{03} + \theta_2 T_{05} + \varepsilon_i$$

Model 4:

$$y_i = \beta_0 + \beta_1 f_i + \beta_2 d_i + \beta_3 (f_i \times d_i) + \lambda_1 (d_i \times DA_{1i}) + \lambda_2 (d_i \times DA_{2i}) + \lambda_3 (d_i \times DO_i) + \theta_1 T_{03} + \theta_2 T_{05} + \varepsilon_i$$

Model 5:

$$y_i = \beta_0 + \beta_1 f_i + \beta_2 d_i + \beta_3 (f_i \times d_i) + \xi_1 (f_i \times d_i \times DA_{1i}) + \xi_2 (f_i \times d_i \times DA_{2i}) + \xi_3 (f_i \times d_i \times DO_i) + \theta_1 T_{03} + \theta_2 T_{05} + \varepsilon_i$$

where DA_{1i}, DA_{2i}, and DO_i are the dummy variables denoting developed Asia Pacific countries, developing Asia Pacific countries, and other developed countries, respectively. The β's, θ's, ψ's, δ's, λ's, and ξ's are the parameters of interest, and the signs of these estimated parameters will indicate if the explanatory variables have positive or negative impact on y.

Since the dependent variable was bounded between 0 and 100, the Double-Limit-Tobit (DLT) method (with heterosekdasticity corrected residuals) was used to capture the relationship between foundation-driver conditions and innovative capacity of countries in Models 1 to 5. The DLT was used in this study because the response variable is bounded in the interval [0, 100]. Details of the DLT model can be found in Greene (2003).

Pair-wise comparison between the coefficients for four country groupings in the models was conducted using the Likelihood Ratio Test (LRT) Statistic, where the distribution for the test statistic follows a chi-square distribution with 1 degree of freedom.

Appendix 3.1B

Table 3B.1

Data definition and sources

Capacity for innovation	Capacity for innovation	Companies obtain technology
		1 = exclusively from licensing or imitating foreign companies
		7 = by conducting formal research and pioneering their own new products & processes
Info-structure	Internet users	Internet users per 100 people
Intellectual capacity	Quality of public schools	The public (free) schools in your country are
		1 = of poor quality
		7 = equal to the best in the world
Incentives	Ease of access to loans	How easy is it to obtain a bank loan in your country with only a good business plan and no collateral?
		1 = impossible
		7 = easy
	Venture capital availability	Entrepreneurs with innovative but risky projects can generally find venture capital in your country
		1 = not true
		7 = true
	Access to credit	During the past year, obtaining credit for your company has become
		1 = more difficult
		7 = easier
	Subsidies and tax credits for firm level R&D	For firms conducting R&D in your country, direct government subsidies to individual companies or R&D tax credits
		1 = never occur
		7 = are widespread and large
Interaction	University-industry research collaboration	In its R&D activity, business collaboration with local universities is
		1 = minimal or non-existent
		7 = intensive and ongoing
	State of cluster development	How common are clusters in your country?
		1 = limited and shallow
		7 = common and deep
Institutions	Burden of regulation by public institutions	Complying with administrative requirements in the country
		1 = burdensome
		7 = not burdensome
	Property rights	Property rights, including over financial assets are
		1 = are poorly defined and not protected by law
		7 = are clearly defined and protected by law
	Intellectual property protection	Intellectual property protection in your country
		1 = is weak or non-existent
		7 = is equal to the world's most stringent
Integrity	Business cost of corruption	Do other firms' illegal payments to influence government policies, laws, or regulations impose costs or otherwise negatively affect your firm?
		1 = impose large cost
		7 = impose no cost/not relevant

Note: The data for internet users for the year 2005 were obtained from Porter et al. (2007). The remaining data were obtained from Porter et al. (2002, 2003, and 2004). All the variables were converted to base 100. The sample size used for this study was 75, 80, and 104, respectively for the three periods.

Table 3B.2

The list of countries

Asia Pacific developed countries	Asia Pacific developing countries	Other developed countries	Other developing countries	
Hong Kong	Bangladesh	Australia	Algeria	Lithuania
Japan	China	Austria	Angola	Macedonia
Korea	India	Belgium	Argentina	Madagascar
Singapore	Indonesia	Canada	Bahrain	Malawi
Taiwan	Malaysia	Cyprus	Bolivia	Mali
	Pakistan	Denmark	Bosnia & Herzegovina	Mauritius
	Philippines	Finland	Botswana	Mexico
	Sri Lanka	France	Brazil	Morocco
	Thailand	Germany	Bulgaria	Mozambique
	Vietnam	Greece	Chad	Namibia
		Iceland	Chile	Nicaragua
		Ireland	Columbia	Nigeria
		Israel	Costa Rica	Panama
		Italy	Croatia	Paraguay
		Luxembourg	Czech Republic	Peru
		Malta	Dominican Republic	Poland
		Netherlands	Ecuador	Romania
		New Zealand	Egypt	Russian Federation
		Norway	El Salvador	Serbia & Montenegro
		Portugal	Estonia	Slovak Republic
		Slovenia	Ethiopia	South Africa
		Spain	Gambia	Trinidad & Tobago
		Sweden	Georgia	Tunisia
		Switzerland	Ghana	Turkey
		United Kingdom	Guatemala	Uganda
		United States	Haiti	Ukraine
			Honduras	United Arab Emirates
			Hungary	Uruguay
			Jamaica	Venezuela
			Jordan	Zambia
			Kenya	Zimbabwe
			Latvia	

Note: The developed countries were defined based on the IMF classification. Since there were insufficient data for countries in the least developed classification (based on IMF classification) for the Asia Pacific region, the IMF classifications for 'emerging countries' and 'under-developed countries' were grouped into one country classification called the 'developing country' classification.

Table 3B.3

The empirical results

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	11.1816**	16.5301	8.8264**	18.1143*	7.4237***
DA_{1_i}		8.1292**			
DA_{2_i}		2.8376***			
DO_i		10.8679*			
f	−0.1729	−0.0614	0.1901	0.0907	0.4959**
d	0.6913*	0.5717*	0.7411*	0.5361*	0.7635*
$f \times d$	0.0041***	0.0017	−0.004138	−0.0005	−0.0089**
$f \times DA_{1_i}$			0.2537*		
$f \times DA_{2_i}$			0.0749		
$f \times DO_i$			0.3250*		

(Table 3B.3 continued)

(Table 3B.3 continued)

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5
$d_i \times DA_{1i}$				0.1191*	
$d_i \times DA_{2i}$				0.0555***	
$d_i \times DO_i$				0.1696*	
$f_i \times d_i \times DA_{1i}$					0.0139*
$f_i \times d_i \times DA_{2i}$					0.0014
$f_i \times d_i \times DO_i$					0.0150*
T_{03}	−3.2491**	−2.9553**	−2.9439**	−2.9588**	−3.0098**
T_{05}	−4.2857**	−3.3365**	−3.5327**	−3.2677**	−3.5908**

Note: The symbols *, **, and *** denote statistical significance at the 1%, 5%, and 10% significance levels, respectively.

Table 3B.4

Pair-wise comparison between country groupings

Test	LRT-Stats	Decision
Model 2		
$H_0: \psi_1 = \psi_2$ $H_A: \psi_1 \neq \psi_2$	1.2663	Accept Null Hypothesis, H_0. The innovative capacity in developed and developing countries in the Asia Pacific is similar.
$H_0: \psi_1 = \psi_3$ $H_A: \psi_1 \neq \psi_3$	0.4608	Accept Null Hypothesis, H_0. The innovative capacity in developed countries in the Asia Pacific region and in the other regions is similar.
$H_0: \psi_2 = \psi_3$ $H_A: \psi_2 \neq \psi_3$	6.4303**	Reject Null Hypothesis, H_0. The innovative capacity in developed countries in the other regions is higher than in developing countries in the Asia Pacific region.
Model 3		
$H_0: \delta_1 = \delta_2$ $H_A: \delta_1 \neq \delta_2$	2.8772***	Reject Null Hypothesis, H_0. The impact of the foundation condition on innovation in developed countries in the Asia Pacific is higher than that in developing countries in the Asia Pacific region.
$H_0: \delta_1 = \delta_3$ $H_A: \delta_1 \neq \delta_3$	1.1277	Accept Null Hypothesis, H_0. The impact of the foundation condition on innovation in developed countries in the Asia Pacific region is similar to that in developed countries in the other regions.
$H_0: \delta_2 = \delta_3$ $H_A: \delta_2 \neq \delta_3$	6.8454*	Reject Null Hypothesis, H_0. The impact of the foundation condition on innovation in developed countries in other regions is higher than that of developing countries in the Asia Pacific region.
Model 4		
$H_0: \lambda_1 = \lambda_2$ $H_A: \lambda_1 \neq \lambda_2$	1.7736	Accept Null Hypothesis, H_0. The impact of the driver condition on innovation in developed countries in the Asia Pacific is similar to that in developing countries in the Asia Pacific region.
$H_0: \lambda_1 = \lambda_3$ $H_A: \lambda_1 \neq \lambda_3$	2.6873***	Reject Null Hypothesis, H_0. The impact of the driver condition on innovation in developed in the Asia Pacific region is lower than that in developed countries from other regions.
$H_0: \lambda_2 = \lambda_3$ $H_A: \lambda_2 \neq \lambda_3$	8.1521*	Reject Null Hypothesis, H_0. The impact of the driver condition on innovation in developed countries in the other regions is higher than in developing countries in the Asia Pacific region.
Model 5		
$H_0: \xi_1 = \xi_2$ $H_A: \xi_1 \neq \xi_2$	3.3313***	Reject Null Hypothesis, H_0. The role of the foundation condition in enhancing the contribution of the driver condition to innovation in developed countries in the Asia Pacific region is higher than that in developing countries in the Asia Pacific region.
$H_0: \xi_1 = \xi_3$ $H_A: \xi_1 \neq \xi_3$	1.8317	Accept Null Hypothesis, H_0. The role of foundation condition in enhancing the contribution of the driver condition to innovation in developed countries in the Asia Pacific region is similar to that of developed countries in the other regions.
$H_0: \xi_2 = \xi_3$ $H_A: \xi_2 \neq \xi_3$	8.5401*	Reject Null Hypothesis, H_0. The role of the foundation condition in enhancing the contribution of the driver condition to innovation in developed countries in the other regions is higher than that in developing countries from the Asia Pacific region.

Note: The symbols *, **, and *** denote statistical significance at the 1%, 5%, and 10% significance levels, respectively.

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Part B

Regional issues in ICT in education

Education for All in the digital age

Distance education in Asia Pacific

ICTs in non-formal education in Asia Pacific

Capacity-building for ICT integration in education

Public-private partnerships in ICT for education

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Education for All *in the digital age*

Tan Sri Dato' Gajaraj **Dhanarajan**

> *The faces of marginalised people are legion. They are the faces of African children wasting away from diarrhea that could be prevented if only their desperate mothers knew how to put together a simple saline solution. They are the faces of struggling farmers in South Asia whose primitive agricultural methods have not changed for generations ... of oppressed minority groups around the world still denied the right to vote.* (UNESCO 1997)

We still live in a world of great inequality. Much of humanity continues to be denied access to an equal share of the planet's wealth, to justice, and to a decent living. The disparity between those who have and those who do not in terms of food, health-care, education, and social security continues to be appalling. The inequalities are not just between rich and poor nations but also within nations and communities.

The elimination of these inequalities is a global aspiration expressed through the Millennium Development Goals (MDGs). The first of the eight goals is the eradication of poverty and three others have to do with improving health (i.e. reducing child mortality; improving maternal health; and combating HIV/AIDS, malaria and other diseases). The seventh goal is ensuring environmental sustainability, and the eighth is developing a global partnership for development. The second and third goals are related to education: achieving universal primary education and promoting gender equality and empowering women specifically through the elimination of gender disparity at all levels of education.

The emphasis on education for development is not surprising. Education has been, and continues to be, the most powerful agent of change. Thus, there is global recognition of education as a basic human right and social responsibility.

This underpins the World Declaration on Education for All that 'every person — child, youth, and adult — should be able to benefit from educational opportunities designed to meet their basic learning needs' (UNESCO 1990a).

In April 2000, some 180 government representatives, donor agencies, and international experts met at the World Education Forum in Dakar, Senegal to assess the progress made by the Education for All initiative that began in 1990. They realized that after 10 years, the world was nowhere near achieving the targets set in Jomtien. Thus, in Dakar, there was a reaffirmation of the global commitment to provide every child with primary basic education of good quality by the year 2015 and during this period to also bring about the equal participation of girls in primary and secondary education, expand early childhood care and education, promote learning and life skills for young people and adults, and improve the quality and relevance of the curriculum and the learning environment. These new targets for the education sector complement those set in other global agendas for development.

Besides target setting, the Dakar Framework for Action also recognized the need to help many nations develop their own action plans to achieve the targets and mobilize resources from all available sources within and outside of national jurisdictions. A further call reiterated the role of civil society in education and the importance of having providers of education commit to defining, designing, maintaining, and sustaining quality in its delivery. All these are tall orders, considering that when the World Conference on Education for All in Jomtien was convened:

- There were more than 960 million adults who were illiterate and two-thirds of them were women and girls;

- More than 100 million children, mostly girls, did not have access to primary schooling;
- More than 100 million children and countless millions of adults were failing to complete their basic education programs, while millions more satisfied school attendance requirements but did not acquire essential knowledge and skills; and
- More than a third of the world's adult population (some two billion individuals) had no access to printed knowledge, new skills and technologies that could improve the quality of their lives and help them to shape social and cultural development.

The region's share in this challenge is considerable. There have been significant achievements in the education sectors in many of the countries in the Asia Pacific. In the close to two decades since Jomtien, participation in primary education has increased; there are more girl children in school; and retention rates are improving, as well as gender equality in the teaching profession and access to post-primary, post-secondary, and professional education. But these achievements still fall short of global ambitions. While the task of getting a larger proportion of our children and young people into schools, colleges, and universities is by itself a daunting one, what is even more challenging is providing learning opportunities for the many millions of adults in the region. Eradicating illiteracy, improving skills, enhancing knowledge bases, creating windows for learning, and ensuring continuous learning are all fundamental to fulfilling the MDGs. And these must be made possible not only for the fortunate few who live in urban communities and who have access to the communications infrastructure and classrooms. The following must also be given education opportunities to enable them to participate in the creation of the knowledge society:

- Those who are functionally illiterate: Apart from about 900 million illiterates globally, there are almost half as many adults who cannot cope with the demands of daily life on the basis of their prior literacy levels.
- The physically challenged: Annually, in Asia alone, about 15 million people become disabled as a result of war, diseases, accidents, and malnutrition. Their major hope of self-improvement is to pick up skills for self-improvement.
- The long-term unemployed: Long-term unemployment is a debilitating pathology; training people in such situations pose special challenges to delivery and pedagogy.
- Out of school youth, especially boys: This group is highly vulnerable to socially disruptive behaviours. A combination of apprenticeship, employment and self-education is needed to help them to contribute to a productive economy.

- Women and girls: In many parts of Asia and the Pacific, women and girls still find themselves marginalized from participating in education and training. Ways have to be found to circumvent the social, cultural, and economic impediments to their education.
- Refugees, recent immigrants and non-nationals: Today, roughly 125 million people live outside their countries of origin. This flow of people for political, social, or economic reasons is not expected to slow down. They and their families need educational programs that will develop their language, social, and job skills.

Governments are also beginning to recognize that planning for 'competitive advantage' will require a labour force that has literacy and numeracy skills beyond three to six years of primary schooling (which is the current situation in most industrialized and newly industrializing countries, and worse in developing countries). Globally, some two billion people in today's workforce will continue to be there well into the first quarter of the next century. They will need retooling and continuous skills upgrading.

The huge demand for initial, continuing and lifelong education has placed education systems 'at a crisis point' (Daniel 1996). The need to expand access, ensure quality, and respond to a diversity of learning needs at a time of diminishing resources presents difficult choices for governments. In confronting these choices, nations, and institutions in the Asia Pacific need to re-examine traditions of schooling, teaching, and learning. And they need to carefully consider the potential of information and communication technologies (ICTs) to meet the demands for universal quality education at all levels.

Even before the arrival of the new ICTs, education institutions such as the Correspondence School of New Zealand, National Open School of India, Open Universities of Sri Lanka and Hong Kong, Alama Iqbal Open University of Pakistan, and Indira Gandhi National Open University of India were providing mass, flexible, and affordable education to remote learners using the older analogue technologies of print, audio and video, and the broadcast vehicles of radio and television. The experiences and successes of these institutions are a testimony to the effectiveness of technologies in taking learning to individuals and large communities simultaneously.

More than two decades ago, Bates (1984) noted that 'developments in technology are bringing advantages to distance teaching and removing some of the disadvantages ... through promises of lower costs, greater student control, more interaction and feedback as well as a wider range of teaching functions and a higher quality of learning'. These remarkable transformations are taking place today not only within the operating environment

of distance education but also in all digitally supported education provision in most parts of the Asia Pacific. Digital technologies are replacing analogue and electromechanical solutions, providing greater functionality at lower costs, and enabling efficient networking and utilization. While the educational community has been somewhat slower in adopting these tools than the business community, the pace has started to pick up over the last 10 years, giving rise to improvements in administrative efficiency, better student record management systems, improved course development protocols, a higher level of learner support, and resource-rich learning environments.

As recently as a decade ago, the choice of technologies for delivering education was somewhat limited, partly because they were expensive, analogue stand-alone technologies with limited versatility, and requiring many skilled technicians to create and deliver the product. But today we have a different picture. The limitation to technology application in education is no longer the versatility, convenience, cost, and potential of the technology, but the limitation of our imagination in the way they can be applied. Through integration, convergence, miniaturization, and intelligence, the technologies have become 'friendly'. The question is no longer whether technologies are useful in the teaching and learning environment but which technologies are best suited for a particular purpose.

Digitization has made it possible to design, develop, deliver, manage, and assess the learning process in many new ways. This is because the new digital technologies are not single technologies but combinations of hardware and software, media, and delivery systems. They are rapidly evolving and converging as seen in personal computers, laptops, notebooks and personal digital assistants; digital cameras; local area networking; the Internet and the World Wide Web; Compact Disc-Read Only Memory (CD-ROM) and digital video discs (DVDs); mobile learning, podcasting, and video sharing tools; and productivity software such as word processors, spreadsheets, simulations, email, digital libraries, computer-mediated conferencing, video conferencing, and virtual reality. The new digital technologies also have a capacity to integrate with the older analogue technologies, making it possible to retrieve information stored in older technologies and to develop synergies between the old and the new.

The new technologies differ significantly from the older technologies in their integration of multimedia, convergence, interactivity, flexibility of use, and connectivity. Until recently, however, their application for development, including education, in the Asia Pacific region has been narrow rather than broad. Fibre optic-based systems, which are a key part of the new information infrastructure in many locations, have not penetrated the peri-urban and rural hinterlands. But coupled with satellite

technologies and working in tandem with other wireless systems, they can provide a window of opportunity for education systems to reach far beyond what until a few years ago could only be imagined.

The use of satellite technologies in delivering education, health services, and telecommunication is well documented. An important part of the ongoing economic, social and technological revolution that has come about with the advent of the Internet age are the opportunities provided by the newest forms of satellite communications technology and applications, such as the World Wide Web, multimedia knowledge products, video-conferencing, and video-lecturing options, as well as enormous amounts of data transmissions. These innovations are helping institutions to reach the unreachable. And they are making possible a paradigm shift in the way educators view teaching and learning.

For one, the new ICTs are stimulating a resurgence of interest in diversifying methods of education delivery. Almost on a daily basis, a Web-based course becomes available from one university or another. 'Smart Schools' are springing up in the richer parts of Asia and 'virtual learning', 'online learning', and other newer forms of educational delivery are becoming part of the educational jargon of the new century. These new developments both reflect and give rise to a growing realization among education providers that in order to successfully implement flexible, easily accessible education reaching the masses, they have to reassess their methods, means, structures, and resources.

In relying more extensively on ICTs in educational provision, education administrators and policymakers will need to attend to eight factors:

- **Policy framework:** There is a need for a clearly articulated national education policy that recognizes and places on an equal footing the various modes of education, including open and distance learning and alternative learning. Such a policy should include provisions for a system of accreditation, adequate funding, quality assurance mechanisms, and support for learners, including bridging programs for those without prior learning experience. In Asia Pacific, countries like India, Malaysia, and the Republic of Korea stand out for their farsightedness in having such a policy framework and implementing it at all levels of the education system, including vocational and teachers training, post-primary education, continuing professional education, and undergraduate and postgraduate education.
- **Unequivocal institutional commitment:** This is especially relevant to conventional institutions that take on off-campus education as an added provision, but fail to provide the resources needed to ensure its sustainability. An absence of

institutional commitment leads to all kinds of bad practice from poor quality course materials to the absence of learner support and a total neglect of the students outside the campus. The promises made to deliver quality education and the expectations raised for all learners must be kept.

- **Investment in staff training:** The range of skills required to function in a multimedia environment is both demanding and daunting. Organizing and running technology-supported distributed learning programs require staff skilled in a variety of tasks. But institutions, enthusiastic about investing in new systems, applications and connections, are often totally unrealistic when it comes to investing in training. It is vital to provide both academic and non-academic staff rigorous training.

- **Preventing commercialization:** The commercial nature of educational ventures, especially from current vendors, is beginning to cause considerable concern among many who wish to see a growth in technology-assisted educational provision. While private enterprise can and does provide valuable education services, the insensitive brand waving and marketing of education as yet another commodity by some will hurt the cause of innovation if profit appears to be its only motivation. As education becomes increasingly 'borderless' and transnational, it is imperative for governments to put regulatory mechanisms in place to ensure that the public has access to quality education and is protected from exploitation by bucket-shop providers and Web cowboys.

- **A clear purpose for applying new technologies:** Technology by itself cannot perform miracles. What is needed is imaginative and creative applications rooted in ground realities and sound training. Apart from the need to develop human capability to use the new technologies, the lack of resources for building the necessary physical infrastructure in a sustainable manner should prompt many governments in the region to take a cautious and well-considered approach to adopting technological solutions.

- **Minding the shift in costs from institutions to individual learners:** New approaches to delivering education on the backbone of cyber pipes are gradually shifting the cost of learning from institutions to learners. Connectivity costs, line charges, and hardware and software costs are being borne by learners few of whom have the level of disposable income to pay for these in addition to tuition and other institutional fees. If providers of education are not mindful, yet another barrier to education can emerge especially for the very communities that these innovations are meant to serve.

- **Leadership to manage change:** Innovations in delivering education require sound management and leadership. Education leaders need to be academically respected, politically

connected, astute, charismatic speakers and interlocutors, and clever strategists and tacticians. They not only must manage change, they will also be required to initiate it. As the environment for education changes, there will be mounting pressure on institutions to respond to this change. Leaders with a capacity to manage the rapid rate of change must be found and empowered.

- **Continuous vigilance to ensure access, equity, and equality of opportunities:** At the heart of educational innovation must be the desire to reach out and reach all. This should be the guiding vision and mission of educators who are committed to the global aspiration of development for all. Similarly, serious attempts have to be made to ensure that equality of opportunity is made possible for all and that those who complete a non-traditional program (e.g. a distance education program) should be allowed to compete effectively for jobs. For this 'parity of esteem' to be achieved, a 'parity of quality' must be ensured.

In *The Death of Distance*, Frances Cairncross (1998) postulated a set of trends in the new communications environment that would influence the way we live, work, and play. While the dot-com boom and bust experience of the late 1990s required a review of these postulations, many still have relevance in the context of educational services. One of these is that the size of an organization does not matter, as small or specialized organizations and even individuals can create and transmit knowledge products to many users (at the users' call) using the power of technology. The other trends that have relevance to the increased use of new technologies in the educational sector are as follows:

- **The death of distance:** The cost of communication will not be determined by distance even in the most regulated environments. Reaching out to students through the electronic highway will be determined more by the willingness of educational providers to utilize the newer technologies than by considerations of cost, as demonstrated by the application of satellite and Web technologies in India and the South Pacific.

- **The cost of appliances:** Such costs will continue to drop even as their computing capacities increase.

- **Location does not matter:** Providers of educational services can be located anywhere on earth and still reach learners wherever they may be as long as there is a basic communication infrastructure. For example, students in India have access to courses in North America without having to be in North America. Similarly, courses in educational institutions in India can and should travel across the globe.

- **Content customization:** Learning can be a multi-channel or a mono-channel experience. The final authority on customization will be the target learning outcomes for the subject and the learning preference of the learner.
- **People as the ultimate scarce resource:** The really difficult challenge for institutions will be to recruit people with the necessary skills to perform the tasks required, as well as to train and retrain those already in service to work in the new environment.
- **Emergence of a global language:** The emergence of English as a dominant second language of science, technology, business, and international relations, as well as education and training, will mean the availability of globally usable knowledge products. There will be an increase in the choice of educational and training courses.
- **Communities of culture:** The opportunity to make available content in languages other than English will become feasible. Declining costs and ease of use of the communication tools will make possible the creation and preservation of cultural products and traditions.

As we look ahead to the future of technology-supported learning in the Asia Pacific region, the challenge will not be the availability, cost, maintenance, and versatility of technologies.

Rather, the challenge will be about the capabilities, capacities, imagination, and aspirations of our institutions of learning and pedagogues to use technologies to their full potential.

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Distance education in Asia Pacific

Jon **Baggaley**, Tian **Belawati**, and Naveed **Malik**

INTRODUCTION

The establishment of the National Extension Institute in the United Kingdom (UK) in 1963 recognized the principle of open education or open learning — that education should be made available to all with minimal restrictions (Perraton 2007). Distance education (DE) technologies have evolved rapidly since then to serve this principle. The open education model stresses the need for flexibility to eliminate barriers to education, such as age, geographic location, time constraints, and economic situation. Open and distance learning[1] (ODL) combines the principles of open and flexible learning with DE methodology and uses information and communication technologies (ICTs) to achieve educational goals that conventional face-to-face methods cannot fulfil because of these barriers.

The same ICTs are used in DE across the Asia Pacific region as in the non-formal and basic education programs reviewed in other chapters in this edition of the *Digital Review of Asia Pacific*. The only functional difference is the formality of the information/communication process — that is, whether or not the messages conveyed lead to formal accreditation for a degree or diploma for example. The current chapter emphasizes the provision of formal, accredited ICT-based higher education, and excludes vocational education, corporate training, and the like. The chapter considers a range of pressing issues affecting Asian DE institutions, such as the lack of access to the Internet obstructing institutional attempts to pursue 'e-learning' course delivery. The chapter also discusses the findings of current needs assessment and user and accessibility surveys conducted by the PAN Asia Networking Distance and Open Resource Access (PANdora) network (2005–2008) funded by the International Development Research Centre (IDRC). Special attention is given to developments in mobile phone usage for education and training in Asia Pacific. Finally, the need for a distinctively Asian approach to DE pedagogy is considered.

THE NEED FOR DISTANCE EDUCATION IN ASIA PACIFIC

Asia's population has risen dramatically in the last 15 years to over 3.7 billion (InternetWorldStats 2008), with major increases in South Asia offsetting decreases in Southeast Asia. This has created critical education and training problems in many Asian countries. Conventional education systems in developing nations do not typically have the capacity to provide secondary, tertiary, and lifelong education to the whole population. The Millennium Development Goals (UN 2008) stress the role to be played by ICT and DE methods in overcoming this limitation both in formal and non-formal education.

ICTs have been used for the past 50 years to increase the efficiency of both face-to-face classroom training and distance-based delivery. The usual reasons for adopting DE methods are (Malik et al. 2005):

1. To widen access to higher education for the masses;
2. To provide continuing formal and non-formal education;
3. To train increasing numbers of students in areas that are target zones for socio-economic development; and
4. To upgrade the qualifications of primary and secondary school teachers.

The number of DE institutions and their student enrolment is increasing annually, indicating a growing acceptance of this mode of education. Of an estimated 44 'mega-universities' (Daniel 1996) worldwide with at least 100,000 students (Wikipedia 2008a), 13 are single mode (DE) open universities and all practice DE in one form or another. Ten of the mega-universities are in Asia, including three in India alone, with a combined student population of approximately 2.1 million. The 10 largest mega-universities include Asian open universities. It may be argued that the China Central Radio and TV University (CCRTVU), with approximately two million students, should be included in this list, although technically the CCRTVU is a combination of separate institutions. It is estimated that 70 Asian institutions currently offer DE programmes to over six million students (Jung 2007).

The University of the South Pacific (USP), one of the earliest DE providers in the region, has offered degree programs to its 12 member countries since 1968. It currently uses a wide range of print materials, audio-conferencing, and Web-based methods. USP's Wide Area Network (USPNet) incorporates a 5 MHz Internet Protocol (IP) satellite technology to integrate the University's DE and administrative functions. Massey University in New Zealand, another early DE adopter, offers a wide range of Web-based programs, and numerous Australian institutions have become world leaders in DE provision, as shown in the activities and publications of the Open and Distance Learning Association of Australia (ODLAA). Worldwide, there is a trend of conventional, face-to-face universities beginning to offer DE programs, thereby converting themselves into dual-mode institutions.

The recognition of DE and ODL as a means of human resource development in Asia is indicated by the establishment of professional organizations, such as the Asian Association of Open Universities (AAOU) in 1987 and the Southeast Asian Ministers of Education Organization Regional Open Learning Center (SEAMOLEC)[2] in 1997. However, DE is still in its infancy in newly transitioned economies like Cambodia, Laos, Mongolia, and Vietnam. It has enormous social potential in Asia Pacific, and research and development is now needed for DE to fulfil its goals.

ICT USAGE IN ASIA PACIFIC DISTANCE EDUCATION

The openness and efficiency of DE and training has been enhanced by ICT developments since the late 1990s. E-Learning methods, which use the Internet to deliver educational content and enable interaction between teachers and students

(Belawati 2003), have allowed ODL to become interactive and personalized while increasing its geographic and socio-demographic penetration. Many non-ODL institutions have adopted e-learning and become dual-mode systems, delivering their courses by DE methods as well as in the classroom. The rapid development of e-learning since 2000 has been greatly assisted by the emergence of open source software (OSS), which makes learning management systems (LMS) widely available and often without cost. With OSS, ODL systems can be created and maintained with relatively low investment.

DE institutions use a comprehensive range of DE technology models. Taylor (2000) describes these in terms of five evolutionary stages, each solving to one degree or another, the problems of geographic distance (place), other commitments (time), and preferred speed of learning (pace) that many students face. The models are: *(i)* the correspondence model; *(ii)* the multimedia model; *(iii)* the telelearning model; *(iv)* the flexible learning model; and *(v)* the intelligent flexible learning model.

This analysis is useful as a general introduction to the range of ICTs available in DE. But it is primarily based on an analysis of the western educational situation, and no technology should be assumed to be appropriate in a particular region without testing. In Australia, Europe, and North America, most ICTs are more universally accessible and more reliable than in Asia Pacific. Panda (2005), for example, has reported that online programs at Indira Gandhi National Open University (IGNOU) in India have only been successful in reaching 'the digitally rich who have access to the Internet or can manage to visit learning and teaching centres regularly'. Furthermore, the high costs of such technologies for students and institutions alike do not appear to be diminishing and will henceforward require 'major increases in expenditure' (Perraton 2007). In addition to accessibility and cost problems, there are capability, technical support, regulatory, and political barriers (Latchem et al. 2008). These may take years to resolve in the least developed countries.

For this reason, mega-universities such as the Open University of Indonesia (Universitas Terbuka: UT) have prudently maintained traditional media alongside online methods (see 'The Open University of Indonesia [Universitas Terbuka]'). Young Asia Pacific universities such as the Virtual University of Pakistan (VU) also deliver their courses by broadcast television while maintaining traditional delivery systems (see 'The Virtual University of Pakistan [VU]'). Print materials remain the dominant delivery technology in DE institutions, not only in Asia Pacific but worldwide, while high-end technologies such as satellite TV provide supplementary support for the educational process.

In the newly transitioned Asia Pacific economies, ICT can play a vital role in the provision of vocational education.

The Open University of Indonesia (Universitas Terbuka)

Indonesia has used DE methods since 1955 to broaden access to education for 215 million Indonesians spread across 15,000 islands. A correspondence diploma program to upgrade teacher skills was created and then integrated with other teacher training programs into the curriculum of the Indonesia Open University (Universitas Terbuka: UT) from its launch in 1984.

UT is the only university in Indonesia using DE modes. Its head office in Jakarta formulates institutional policies for the development and production of course materials, test/examination items, and examinations data processing, and 37 regional offices are responsible for daily operations, student registration, face-to-face tutorials, administrative counselling, and examinations. All units are connected through the University's wide area network (WAN), which uses a public Internet connection soon to be connected with all State universities using the Ministry of National Education's Intranet system called INHERENT.

The University offers approximately 1,000 courses through 31 study programs in four faculties — Economics, Social and Political Sciences, Mathematics and Natural Science, and Teacher Training and Educational Sciences — and three graduate programs. All course content is delivered through printed learning modules, and 25 percent of course materials are multimedia packages (audio/video-tapes, radio and TV broadcasts, and computer- and Web-based materials). Learning support is provided via face-to-face, online, and broadcast modes. Radio tutorials are broadcast by the government-owned National Radio Station Network. Online courses use a learning management system based on Moodle™. All online support services can be accessed by students through the UT-Online portal, which contains on-line tutorials and exercises, Web-based learning materials, streamed TV programs, a digital library with journals and transcripts, academic counselling, e-book store, and online registration and examination facilities. However, due to students' limited Internet access, only about 5 percent of them are currently taking advantage of these online services. Ongoing surveys show that students still regard print as the most accessible, affordable, and preferred medium.

The Universitas Terbuka website is at www.ut.ac.id.

Hutchinson (2005) provides a detailed evaluation of the first trial of e-learning in Cambodia, conducted at the International Institute of Cambodia University of Technology. The study indicates that e-learning can increase students' confidence in online learning. The students said they gained new knowledge and skills from learning in the Khmer script, and appreciated being able to obtain educational services without having to travel to the University in Phnom Penh. The courses also increased their eligibility for jobs: 56 percent of them gained a new job or were promoted in their current organization after completing the online course. In general, the e-learning trial was considered a successful pilot validating the potential of e-learning in Cambodia and the enthusiasm of students for it. But the trial was not without problems. Factors receiving the lowest ratings in Hutchinson's study related to the lack of institutional support for the online process, and the continuing negative perception of DE on the part of politicians and the general public. The results suggest that this perception derives from the association of 'good education' with the student's ability to ask a question and the teacher's ability to give an immediate answer, and with the ability to see the participants' expressions and gestures.

Lack of infrastructure, course materials, and technical support have also been noted in other evaluative studies of online education in Asia Pacific (Baggaley and Belawati 2007; Latchem et al. 2008). However, negative conclusions of this type do not seem to be deterring Asia Pacific educators from attempting to implement online DE. The danger is that rushing to implement online DE methods before addressing issues of inaccessibility and ineffectiveness may damage the credibility of DE. Prior to their adoption in new geographic areas and cultures, new online media needs to be carefully evaluated. Some of the necessary measures are rapid adoption of appropriate technologies (e.g. high-compression audio-conferencing) and intensive training and awareness programs informing teachers and the public about the new technologies and practices that make e-learning an increasingly reliable and valid option.

A promising set of conclusions is emerging from the work of the PANdora network, a major collaboration among 13 Asian nations in the development of policy and practice for ICT usage in DE and training contexts funded by IDRC (see Appendix 5.1A). Doung et al. (2008) have reported a study of DE attitudes and technologies in Cambodia, Laos, and Vietnam, with a sample size of 130 teachers, students, and government workers, and with a particular emphasis on gender issues. Their results indicate differences in the use of ICTs between the males (71 percent) and females (29 percent) in the sample. For the men and women

The Virtual University of Pakistan (VU)

Pakistan has a population of 160 million, almost half of which is below the age of 30. In 1999, the established universities stated that they could not cope with the increasing student numbers and lack of qualified faculty. In 2000, the establishment of a 'virtual' university became part of the action plan drawn up by the government to fulfil the nation's ICT needs. The plan for a Virtual University of Pakistan (VU) was approved and funded in 2001, and the first VU students were admitted in 2002 into a four-year BS program in Computer Science/Information Technology.

It was recognized from the outset that it would take many years for broadband Internet to become available nationwide, and it was decided that courses would be delivered via four free-to-air satellite TV channels, with mentoring, tutoring, and teacher–student interaction occurring on the Internet. VU engages world-class resource persons to prepare and deliver lectures from the University's studios. Animation and slides are added by the VU graphics department, and lecture notes and handouts are provided in print form and through VU's online learning management system.

The servers used for VU's website, email system, and learning management system are state-of-the-art machines with redundant power supplies and RAID hard discs. They are located on a 155 Mbps fibre trunk linking to Pakistan's main router on the national backbone. VU's TV channels use Pakistan's first communications satellite (PAKSAT-I). The strategic placement of the servers on the national backbone and the use of the national satellite ensure that any breakdown in international links does not affect university operations.

Although 2002–2007 student enrolment statistics showed a wary attitude to the University on the part of the general public, rapidly increasing student numbers since 2005 have indicated greater acceptance of its ICT-based DE methods. In just six years, VU has been able to establish its credentials as an institution providing quality higher education using a judicious combination of broadcast television with high production-value lectures, Internet support, and student assessment conducted in conventional academic environments.

The VU website is at www.vu.edu.pk.

alike, many DE technologies (e.g. online discussions and text-chats/instant messaging, Internet telephone, and audio/video-conferencing) are inaccessible. But in the case of the more familiar technologies such as texting via cellphones, the women report more frequent usage than the men. The women's attitudes to ICT and DE are also more positive than those of the men, who are more inclined to doubt that DE can ever equal face-to-face education and that politicians and the public will ever accept it. One may speculate that women are more supportive of DE technologies owing to their more positive attitude to study and self-improvement, which in turn may derive from traditional social roles making education more unattainable for women (Chang 2006; Loh-Ludher 2007).

Another PANdora project has investigated gender issues in educational ICT usage in Bhutan, Pakistan, and Sri Lanka (Samaranayake et al. 2008). The study compared male and female students' attitudes to computers in work and study settings, as well as their work habits and learning styles. Numerous differences are reported between responses given in the three countries and between response of the men and women in each country. So many gender-country interaction effects are observed (e.g. men and women in Sri Lanka showing different gender biases than those observed in Bhutan) that further analysis is needed to confirm these gender-based trends. In general, the study supports the conclusions reported by Champagne and Walter (2000) about the great diversity and differences among Asian learners as a whole, and the lack of clear evidence of a uniquely 'Asian' learning style (see 'A Distinctly Asia Pacific Pedagogy?').

In general, the PANdora network's research findings confirm the conclusions reported by Hutchinson (2005) and others, and indicate a major need for organizational upgrading and training to advance DE in the region. Other countries in which similar results have been found include India, Indonesia, Laos, Mongolia, the Philippines, and Thailand. To deal with the need for training and information programs about DE in the region, the PANdora project (www.pandora-asia.org) has released an extensive series of DE publications and guidelines.

CURRENT PRIORITIES IN DISTANCE EDUCATION IN ASIA PACIFIC

A major conclusion of evaluation studies of DE in Asia Pacific has to with the need to upgrade the infrastructure for Internet-based education to enable educational institutions to take full

advantage of it. It is ironic that the most fundamental problem of Internet-based DE in Asia Pacific — the widespread lack of Internet access — has received relatively little discussion. Hardhono et al. (2007) have attributed the neglect of this basic issue to a tendency on the part of some Asian institutions to adopt online methods 'as a major symbol of their modernisation', rather than basing the decision on the results of research and evaluation of e-learning accessibility.

Samaranayake et al. (2007) have shown that while most students in South Asia use computers, very few have Internet access. In Sri Lanka, 79 percent use offline computers in their educational institutions, and among those who have access to the Internet, 42 percent have online access at home, and 35 percent use Internet kiosks. In Pakistan, these proportions are lower in all categories, with 42 percent of students using institutional offline computers and 30 percent or less using facilities like email, Web-based training materials, and text-chat/instant messaging. In Bhutan, the figures are lower still: following an e-learning trial, 83 percent of the student users reported that they had difficulty using the online method due to poor Internet connections, insufficient time, the complexity of the method, and/or the need to travel far to get Internet access. e-Learning is proving more successful in India than elsewhere in the region, although primarily in the corporate sector where access is more readily available.

In an attempt to quantify the issue of Web inaccessibility, the 13-country PANdora network has conducted a study measuring the time taken to access webpages between major Asian cities. The finding: 'In most of the survey conditions, browser loading times were noted up to four times slower than commonly prescribed as acceptable. Failure of pages to load at all was frequent …' (Baggaley et al. 2007). The study also analyzed the routes taken by Web hits (i.e. attempts to access material from Web servers) at Asian institutions. All Web hits go through intermediate Web servers before reaching their target, and the more intermediate 'hops' involved, the bigger the chance that the access attempt will fail. The study showed that whereas hits by students in Canada on Canadian Web servers may go through half a dozen hops, Web hits by Asia Pacific users commonly go through 20 or more hops and fail to reach their destinations altogether. In addition, the study found that Asian Web hits are commonly routed through countries such as Russia and the United States, for want of more direct local routes. In Cambodia, attempts to access material on a Web server in the next building are typically routed through Vietnam, adding to the time taken and the chance that the Web hit will fail. Improved local Web routes are needed to address this problem.

The substantial extra workload created for the teachers when online methods are considered for adoption also need careful attention. In traditional educational institutions, the use of pre-produced material does not require continuous preparation by the instructors during the academic semester. When online methods are used, the instructor is required to attend to the teaching-learning process constantly, or at least as regularly as in face-to-face instruction.

Meanwhile, most South Asian students have access to other media, such as radio and television, which continue to be used as major educational media by the Asia Pacific mega-universities. In adopting modern technologies in the educational process, Asia Pacific distance educators ought not to abandon traditional media, especially since these technologies are more widely accessible than the Internet and Web in all parts of the world.

One country, Vietnam, is proving successful in the development of e-learning owing in part to its detailed ICT and DE policies (Doung et al. 2007). These include specific policies about DE and the ICT applications supporting it (e.g. use of Open Source software), and a high priority given to vocational training and the education of remote communities.

In countries like Indonesia (Universitas Terbuka), Mongolia (Infocon Ltd), and the Philippines (University of the Philippines Open University and the Molave Foundation), the focus of e-learning innovations is the cellphone, which is the most accessible of all modern media in the region. Software is being developed to enable students to use their cellphones to request information from the University, and to allow educators to use cellphones in 'pushing' information to students.

Librero et al. (2007) discuss four types of educational cellphone usage in the Philippines:

1. The cellphone and its short message service/texting (SMS) feature are used as the primary medium for interactive learning.
2. Texting is used to inform students of schedule changes, deadlines, examination regulations, grades, new courses, and library resources.
3. Student groups and organizations use the cellphone to publicize social activities, job fairs, book discounts, etc., and for voting in student elections.
4. University administrators use cellphones to coordinate the admissions process, to conduct marketing campaigns, and to announce grants, surveys and policies, and emergency information (e.g. bad weather, suspension of classes).

Ramos and Trinona (2007) have reported a positive response from the students and the public in Mongolia and the Philippines to the idea of developing cellphone techniques for educational

purposes. Students can access learning materials on CDs and DVD, while using automated cellphone methods to interact with their teachers and University administrators on assignment grading for example.

In addition, teams in Mongolia and the Philippines are working with researchers at the University of Colombo, Sri Lanka, to develop software and LMS modules permitting audio- and video-conferencing over low-speed Internet connections, and a PANdora collaboration between Sri Lanka and Pakistan is developing online software for interactive student assessment (e-assessment) based on Asia Pacific needs (Baggaley and Belawati 2007).

In Cambodia, Indonesia, and Thailand, Hardhono et al. (2007) have developed an online repository of 'learning objects' (LOs) to enable course developers in the three countries to share course materials. The value of this approach in Asia Pacific has yet to be proven. Numerous attempts to create learning object repositories of this kind have been made internationally, with mixed results. On one hand, it is useful for DE institutions to develop digital course materials that can be shared online, and the Hardhono et al. (2007) project is based on the laudable goal of reducing costs by sharing culturally appropriate and compatible objects between different Asian countries. On the other hand, the costs of producing and updating digital materials may prove prohibitive in the Asia Pacific context, and it is by no means certain whether teachers will be willing to share the teaching materials they develop or to use those developed by other teachers. They may also be suspicious of attempts by large international organizations (e.g. publishing groups, commercial Web portals) to impose educational materials on them. Automated approaches to DE have been disparaged as 'digital diploma mills' (Noble 1998), and as a cafeteria-style of education serving private sector interests at the cost of educational excellence (Moll and Robertson 1998). The 'oligopological' control of information by a relative few reinforces such criticisms.

Many of the problems currently jeopardizing DE initiatives in the region can be addressed by adjusting institutional funding and management practices to make them more specifically attuned to DE and ICT needs. In conventional institutions based on face-to-face teaching and learning, funding needs vary according to student numbers and the demand for sufficient teachers and classroom facilities. For institutions where education relies on the use of ICTs, funding is less sensitive to student numbers and more influenced by the types of technology used. For example, synchronous support technologies such as audio/video-conferencing require more funding than asynchronous methods. A comprehensive set of examples of how DE

administration is practised in several ODL institutions in Asia (i.e. at the China Central Radio and TV University system, Korea National Open University, Sukhothai Thammathirat Open Unversity, Universitas Terbuka, Virtual University of Pakistan, and Wawasan Open University) is given by Belawati and Baggaley (2008).

A DISTINCTLY ASIA PACIFIC PEDAGOGY?

Dramatic advances in ICT development in Asia Pacific have opened numerous opportunities for DE in the region. But until the hurdles of accessibility have been overcome, the benefits of online learning applications, including Web 2.0 technologies,[3] in specific parts of Asia Pacific will need to be assessed. Careful management and budgeting may partially overcome the problems, allowing educators to develop mixed-media approaches to DE that can effectively address the region's critical educational challenges. But it is essential that educational institutions do not rush to judgement about the pros and cons of DE technologies before they have been carefully evaluated.

The evaluation process should also consider whether students in Asia and the Pacific need a distinct DE pedagogy. Since many of the new ICT-based pedagogies in Asian DE have originated in the west, it is debatable whether they are appropriate to Asian learning styles. Strother (2003), for example, suggests that in an interactive audio-conference:

> An Asian learner may have a difficult time overcoming his or her traditional role as respectful listener. An Asian learner who has never worked with computer-aided instruction may find it difficult to cope with learning the system while having to master the content delivered through the system.

On the other hand, Champagne and Walter (2000) have observed numerous learning styles in different Asian contexts. Following teaching experiences in various Asian nations, they came to recognize 'the vast diversity and differences among Asian learners and perspectives, to the extent that we no longer find "Asian" to be a particularly useful concept'. The current writers have come to the same conclusion following their extensive exposure to DE practices and attitudes in the 13 Asian countries involved in the PANdora project.

In general, the PANdora surveys of attitudes to DE accessibility and acceptability have shown a preference by students throughout the region for a more interactive style of education

than they are typically given (Baggaley and Belawati 2007). These conclusions have been verified by students in Bhutan, India, Pakistan, and Sri Lanka (Samaranayake et al. 2007), and in Cambodia, Laos, and Vietnam (Doung et al. 2007). It would seem that students the world over learn best from an active, engaging pedagogy. And it may well be that Asia Pacific teachers tend not to provide their students with new, interactive methods owing to their greater comfort level with the older didactic styles. Whether fundamental philosophical beliefs account for the prevalence of one-way didactic styles in Asia Pacific, or are merely used as an excuse for them, remains a matter for investigation. The resolution of such questions will be fundamental to the increasing social role of distance education in the region.

NOTES

1. The terms 'education' and 'learning' are used interchangeably in the international DE and ODL literature.
2. SEAMOLEC operates for the benefit of nations including Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.
3. Web 2.0 is a term describing changing trends in the use of World Wide Web technology toward enhanced creativity, secure information sharing and collaboration. Web 2.0 applications include social networking sites, video sharing sites, wikis, and blogs (Wikipedia 2008b).

APPENDIX

Appendix 5.1A
The PANdora Asian DE network

The PANdora network project (2005–2008) is a unique collaborative initiative designed to develop the potential of DE across Asia. Sponsored by IDRC in Ottawa, Canada and operated by its PAN Asia division in Singapore, the project includes nine research and development (R&D) sub-projects involving DE specialists in 13 Asian nations: Bhutan, Cambodia, China, Hong Kong, India, Indonesia, Laos, Mongolia, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam. The acronym 'PANdora' stands for 'PAN Asia Networking Distance and Open Resource Access'.

The nine PANdora sub-projects have addressed:

1. Accessibility, acceptance, and effects of DE technologies
2. Viability of mobile SMS technologies for non-formal DE
3. Evaluation and adaptation of DE open source software
4. ICT-based distance teacher education
5. Instructional design training for ICT-based DE
6. A repository of reusable learning objects for Asian DE
7. e-Assessment methods and models for student evaluation
8. Best practices in DE technology for capacity-building
9. DE practices for policy recommendations

The organizations participating in the 2005–2008 PANdora project include:

*   Allama Iqbal Open University (AIOU), Pakistan
*   English for Special Purposes Foundation (ESPF), Mongolia
*   Fisheries College, Bac Ninh, Vietnam

*   Health Sciences University of Mongolia (HSUM)
*   Ho Chi Minh City Open University, Vietnam
*   ICT4D ASEAN Collaboratory, Indonesia
*   Indira Gandhi National Open University (IGNOU), India
*   InfoCon Ltd, Ulaanbaatar, Mongolia
*   Institute of Information Technology (IIT), Vietnam
*   Ministry of Education, Youth, and Sports (MoEYS), Cambodia
*   Molave Development Foundation, Philippines
*   National Science Council, Lao PDR
*   Phnom Penh International University (PPIU), formerly IIC
*   Royal Government of Cambodia
*   Samtse College of Education, Royal University of Bhutan
*   Science Technology and Environment Agency (STEA), Laos
*   Sukhothai Thammathirat Open University (STOU), Thailand
*   Universitas Terbuka (UT), Indonesia
*   University of Colombo School of Computing, Sri Lanka
*   University of Hong Kong (UHK)
*   University of the Philippines Open University (UPOU)
*   Virtual University of Pakistan (VU)

The PANdora project has generated three volumes of project conclusions, a modular guidebook containing practical guidelines for DE development and administration in Asian educational institutions, conference papers, articles in academic journals, policy briefs, and online audio discussions. The project website is at www.pandora-asia.org.

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ICTs in non-formal education in Asia Pacific

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BACKGROUND

Although education is a basic human right, there are millions of individuals who have not been provided an opportunity for schooling and other means to become literate. It is for this reason that non-formal education (NFE) programs for out-of-school youth and adults have been promoted in most countries of the world. In many countries, NFE forms an integral part of the official programs of basic education, often with independent organizational arrangements as well as a program budget and portfolio of activities.

Over the last two decades, rapid economic, social, and technological changes have taken place globally. Economists acknowledge that, increasingly, knowledge and technology are playing a significant role in what is termed as the 'knowledge economy'. A linked development, sometimes called the 'information society', is taking place due to the advent and spread of information and communication technologies (ICTs) in varying degrees, through all the countries of the world. But while educational applications of technology would be made available to school-based programs, there is a strong possibility that due to scarce resources, the poorest and the marginalized groups will remain excluded in this kind of provisioning. Thus, there is a real danger that with the growing importance of ICTs in knowledge-based societies, groups with little or no literacy will fall further behind those who are literate, and the existing literacy gap will grow even wider. Undoubtedly, this would exacerbate the problem of the digital divide.

NFE has a critical role to play in reaching marginalized groups, and ICTs are a tool in the effective performance of this role. The present chapter critically examines the progress made and the lessons learnt in the use of ICTs in non-formal education in the Asia Pacific region.

A NEW PERSPECTIVE ON NON-FORMAL EDUCATION

NFE has always been loosely defined, and in developing countries, it has come to represent a large variety of programs spanning a wide range of age groups, target populations, and content areas. The concept of NFE needs to be unpacked to better understand the various nuances associated with the term in differing contexts and in changing times.

The original version of NFE emerged in the late 1960s and early 1970s. Coombs (1968) and Coombs and Ahmed (1974) defined NFE as an alternative form of education for adults and children that occurred outside of the traditional classroom environment. The need for NFE arose in the context of the widespread disillusionment with formal schooling in the 1970s (Illich 1973). NFE was then seen as a panacea for the ills of education in developed and developing countries (Freire 1972), and aid agencies made substantial investments in NFE from the late 1960s to the 1980s.

The 1990s witnessed a growing ambivalence toward NFE programs as they became associated with second rate educational programs catering to the needs of poor and marginalized groups. Because accreditation frameworks were weak or non-existent in most countries, NFE students suffered a disadvantage vis-à-vis those from the formal education stream in either not being certified or in not getting absorbed in the job market.

More recently, NFE has undergone a resurgence in developing countries because of the realization that formal schooling, in its present form, has limited reach. Furthermore, it is now recognized that the educational needs of young people and adults are varied and should be addressed through suitable programs. In developed countries, NFE has assumed importance in the context of lifelong learning, which sees learning as taking place not only in schools and colleges, but throughout the lifespan, in many different locations and times and in formal, non-formal, and informal modes.

With the growing interest in NFE, it is necessary to understand what constitutes NFE and how it relates to formal and informal education, particularly in light of the diversity of formal education at present. For example, is open and distance learning part of formal or non-formal education? Are private commercial educational programs that lead to various kinds certification part of the formal system? What about e-learning? The boundaries between formal and non-formal education are becoming increasingly blurred. Even within non-formal education, there is a wide continuum of educational programs. At one end is the flexible schooling model that now exists in a number of countries, while at the other end are the highly participatory educational programs that are designed to suit the learning needs of each particular learning group.

Earlier approaches regarded formal, non-formal, and informal education as distinct categories. In contrast, Rogers (2004) proposes that they be viewed as part of a continuum, with fine gradations between them and blurred boundaries. According to Rogers, the key distinction between these three categories of education would lie in the individualization of learning. While formal education would be highly de-contextualized, standardized, and generalized, informal learning would be highly contextualized[1] and non-formal learning would be a hybrid that would include informal learning as well as formal learning.

Most countries in the Asia Pacific region have actively promoted NFE programs for out-of-school youth and adults. Many of these programs were well under way even before the Education for All (EFA) Conference held in Jomtien, Thailand, in 1990. In fact, by then most countries in the region had already established separate organizational arrangements for promoting NFE as an effective channel of basic education. Apart from national NFE programs initiated by governments, the last decade has also witnessed the emergence of non-governmental initiatives in NFE.

The current emphasis on creating 'knowledge-based' societies has made 'learning' throughout life more important, which in turn requires an education system to have greater flexibility to enable learners to enter and leave the system at different points. Thus, accreditation and equivalency and other synergies

between the formal and the non-formal learning sectors have become essential. Moreover, a wide range of education providers, including universities, NGOs, government agencies, and the private sector, needs to be involved, particularly because learners, who have diverse learning styles, would need different kinds of skills from formal, non-formal, informal, and distance and open learning institutions.

A joint research project undertaken by member institutions of the Asia Pacific Programme of Education for All (APPEAL) Resource and Training Consortium (ARTC) to document and disseminate innovative approaches to NFE and lifelong learning in the region classifies NFE innovations in the region under three broad categories (UNESCO 2002):

- Functional literacy and adult education for poverty alleviation, as illustrated by case studies from Bangladesh and China. The Bangladesh case study with contributions from 16 NGOs gives considerable attention to linking literacy with economic activities. On the other hand, the study from China highlights that inter-sectoral coordination is critical for lifelong learning and also for linking education with poverty alleviation.

- Non-formal education for sustainable development, as in case studies from India, Indonesia, the Philippines, and Thailand. The Indian study focuses on the importance of linking NFE programs to demand from the local community and developing locally relevant curricula. In the Indonesian and Philippines case studies, it is the equivalency of the NFE program with the formal educational system that forms the basis for sustainable development, viewed as lifelong learning linked to economic improvement. The case study from Thailand demonstrates an effective approach to sustainable development through building the capacity of the rural population for community-based action in marketing.

- NFE as lifelong learning, as in case studies from Australia, Malaysia, and South Korea. The Australian case study highlights an innovative education program that enabled farmers in Queensland to assess their current situation and improve their confidence in their own ability to make strategic choices, resulting in a better quality of life, more profitable farming, and improvements in the management of land and other natural resources. The Malaysian case study focuses on the effectiveness of a lifelong learning project for capacity-building among rural youth and adults through a massive computer literacy training program. The South Korean case study describes the Credit Banking System (CBS), an open education system that recognizes diverse learning experiences not only in school but also out of school. Thus, when a student accumulates the requisite CBS-approved credits, she or he

can obtain an associate or bachelor's degree. Thus, CBS provides citizens with greater access to various educational opportunities and fosters lifelong learning.

On the whole, the case studies demonstrate that NFE is gaining ground in many countries in the Asia Pacific region. NFE programs are expanding even in countries with a high level of basic education coverage and these programs are making the formal system more flexible. In fact, in most countries, NFE programs are evolving into a potential mechanism for meeting the emerging educational needs of people more effectively than the formal system of education.

ICT IN NON-FORMAL EDUCATION IN ASIA PACIFIC

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) Education for All Global Monitoring Report for 2008, there are 774 million illiterate adults globally. Almost all of them live in developing countries, particularly in South and West Asia, sub-Saharan Africa, and the Arab States where the literacy rates are about 60 percent. Women account for 64 percent of adults who cannot read and write with understanding. The problem of illiteracy among women is particularly grave in the South Asian region. Most of the illiterate women are poor, live in rural areas, are older in age, and belong to linguistic, ethnic, and religious minorities.

Achieving education for all and eradicating illiteracy by 2015 are among the Millennium Development Goals (MDGs) that the global community has set for itself. The education-related MDGs build on the EFA initiative agreed in Jomtien, Thailand in 1990 and reaffirmed at the second EFA meeting in Dakar, Senegal in 2000. In addition, the United Nations launched the UN Literacy Decade (2003–2012), which adopts the Literacy Initiative for Empowerment (LIFE) as a global strategic framework for assisting the 35 countries in which 85 percent of the world's non-literate population lives.

Because of the established relationship between illiteracy and poverty, achieving the goals of the UN Literacy Decade is central to the realization of the MDGs. The International Action Plan for implementing the UN Literacy Decade states that 'literacy for all is at the heart of basic education for all and creating literate environments and societies is essential for ... eradicating poverty, reducing child mortality, curbing population growth, achieving gender equality and ensuring sustainable development, peace and democracy' (UNESCO 2002).

The Action Plan calls for a renewed vision of literacy that goes beyond the limited view that has hitherto been dominant:

'It has become necessary for all people to learn new literacies and develop the ability to locate, evaluate and effectively use information in multiple manners' (UNESCO 2002, p. 4). In particular, people need to learn skills that are essential in what is now called the 'knowledge economy' and 'information society' where knowledge and technology, including ICTs, are increasingly playing a significant role and causing social transformation to take place at a rapid pace. Personal participation in knowledge- and technology-driven societies begins with literacy (Wagner and Kozma 2005), but requires continuing education and training throughout the lifespan. NFE programs, with their needs-based approach and flexibility, have an important responsibility to ensure that illiterate adults and out-of-school youth and children, as well as other marginalized and disadvantaged groups, are provided opportunities to access ICTs and to utilize them meaningfully to further their socio-economic growth and development.

In 2002, APPEAL launched the ICT-NFE project with financial support from the Japanese Funds-in-Trust to explore the use of ICTs in the delivery of education and skills training to help improve quality of life, alleviate poverty, and achieve community development through community learning centres (CLCs) and other community-based mechanisms. The project piloted the use of ICTs to foster the participation of disadvantaged communities in literacy, basic education, and continuing education activities in Indonesia, Lao PDR, Sri Lanka, Thailand, and Uzbekistan.

The ARTC study that was undertaken in 2002 (UNESCO 2002) and the APPEAL study (UNESCO 2005) highlight the following lessons learned regarding the success of NFE programs as well as the potential benefits of integrating ICTs in NFE programs.

The success of NFE programs has been found to depend on the following factors:

1. A broader definition and scope of NFE: Non-formal learning should no longer be viewed in a narrow way but as part of lifelong learning.

2. Community involvement: The involvement of local communities in the planning and management of NFE programs is vital to ensure that the programs are relevant to their needs and to develop a sense of ownership.

3. Local demand: A demand-driven paradigm for initiating NFE programs not only ensures effective use of the resources but also reinforces accountability among participants.

4. Continued government support: Since NFE programs generally meet the educational needs of marginalized groups, they are invariably dependent on support from the government or from donor agencies.

5. Linking literacy with economic activities: It is essential for NFE programs to go beyond literacy programs and offer functional education that can promote economic development and improve the quality of life of individuals and the community.

6. Addressing the issue of poverty alleviation: Since NFE programs target poorer sections of the society, they need to address the issue of poverty alleviation. Well-designed NFE programs have the potential to alleviate problems arising out of poverty.

7. Multi-sectoral participation: While most educational programs tend to be confined to the educational bureaucracy, NFE programs that attempt to link education with the economic and social aspects of people's lives need the collaboration of professionals and administrators from the relevant agencies and organizations in the government and non-government sectors.

Integrating ICTs in NFE programs can help meet these requisites for success thus:

- ICT can be used to develop livelihood skills and thus contribute to poverty alleviation: Livelihood skills training is a common activity in CLCs. The use of ICTs as a tool in such training is an engaging way for learners to develop these livelihood skills (UNESCO 2005).

- ICT is a tool for capacity-building: More specifically, ICT can be used as an effective and affordable tool in the professional development of NFE teachers. This is important because although qualified and trained teachers are the key to quality learning and increased learner motivation, in many countries professional expertise, particularly for the provision of non-formal literacy education, is limited and thinly distributed, and training in teaching and learning in NFE contexts consists of one-off programs and lack follow-up and sustainability.

NFE programs can also help develop the digital skills that are now required in public service at the central, provincial, district, and community levels.

- ICT can facilitate documentation and information sharing: ICT can facilitate the print, visual, and video documentation that is needed for the dissemination of information about successful NFE projects. When undertaken by the members of the community, this documentation can help foster a sense of community pride and ownership and ensure continuing support and enthusiastic participation. And while ICTs can promote information sharing between communities, they can also be effectively used to mobilize policy dialogue on the use of ICT for community empowerment.

- ICT can be used to facilitate the process of networking among organizations engaged in the design and delivery of NFE programs: It is essential for the government and other organizations to coordinate their NFE activities to maximize available resources and expertise, including ICT equipment.

- ICT tools can improve the overall effectiveness of monitoring and evaluation: Monitoring and evaluation should be built into the entire planning and management of NFE programs.

- ICT can be used in promoting literacy for community empowerment: Dighe and Reddi (2006) present case studies from India highlighting the effective use of technology to empower rural women in particular. One case study is of the Deccan Development Society (DDS), which has trained poor *dalit* (the Indian social classification for the poorest and the 'untouchables' in the caste system) women in the Medak district of Andhra Pradesh, India, to use video technologies to represent their lives and redefine their status. In Machnoor village, DDS has set up a community radio station with a 100-watt FM transmitter and a 30-kilometre radius reach where, with the support of UNESCO, a small team of *dalit* women has recorded 300 hours of programming on issues relating to women's empowerment, agricultural needs of semi-arid regions, public health and hygiene, indigenous knowledge systems, biodiversity, and food security. They have also recorded local songs and drama. In Ahmedabad, India, Self-employed Women's Association (SEWA) has been using video as a tool for women's empowerment since the mid-1980s. Video is used as a medium to share information with the women members of SEWA and also as a tool for training and teaching new skills and for reaching policymakers.

Currently there are three types of learning spaces where ICTs are used to enhance NFE: telecentres, Community Multimedia Centres (CMCs) and CLCs.

A telecentre is a public space where community members can access telephones, computers, the Internet, and other digital technologies that can help them gather information and communicate with others. The simplest kind of telecentre is a booth in which the owner of a cellphone sells user-time. This has worked well in countries like Bangladesh where the Grameen Bank has been lending money to rural women to buy cellphones since 1997. A telecentre has a limited educational function but it is empowering to those who are enabled to access information easily. In the case of Grameen Bank, it has also helped in

alleviating poverty by augmenting the income of the village women in Bangladesh.

CMCs are non-profit telecentres that aim to promote community empowerment and address the problem of the digital divide. Also known as a community e-centre (CeC), a CMC combines community telecentre facilities (computers with Internet and email, phone, fax, and photocopying services) with a community radio run by local people in the local language. The radio, which is low-cost and easy to operate, not only informs, educates and entertains, but also empowers the community by giving a strong public voice to the voiceless and encouraging greater accountability in public affairs. CMCs provide a gateway to active membership in knowledge societies by enabling everyone to gain access to information and communication tools that they can use to improve the quality of their lives.

UNESCO (2007) defines a CLC as 'a local place of learning outside the formal education system ... usually set up and managed by local people for local people'. CLCs, which may be located in urban and rural areas, 'are home-grown institutions that ... provide education programs that address the specific needs and desires of the populations they serve'. Their aim 'is to help individuals empower themselves and promote community development through lifelong education for all people in the community, including adults, youth, and children of all ages. A CLC does not necessarily require new infrastructure, but can operate from an existing health center, temple, mosque, primary school or other suitable venue'.

Of all APPEAL-supported regional projects none has generated greater enthusiasm among APEC member states than the CLC project. Initiated in the late 1990s, it has attracted over 20 countries in the region to try out community-based models for learning at the local level. Several countries that have piloted the development of CLCs with the support of APPEAL have now developed models that are being replicated with the support of communities, governments, and other partners.

FACTORS FOR SUCCESS OF ICT-SUPPORTED NON-FORMAL EDUCATION

Simply using ICTs in NFE programs does not make for effective NFE programs. For the potential benefits of ICT integration in NFE to be realized, several factors need to be considered.

The first of these is the need for a coherent policy for integrating ICT in NFE. A meta-survey of ICT integration in 44 countries in the Asia Pacific region conducted by UNESCO Bangkok in 2003–2004 (Farrell and Wachholz 2004) showed

countries at different stages with regard to policies pertaining to the integration of ICT in the education system. While all of the countries surveyed had stated that the development of ICT capacity was important to national development, few had grappled with the policy questions related to ICT applications in education, especially in NFE. Few policymakers demonstrated a commitment to ensuring that ICT would be adopted at a mass level.

A policy framework is essential as it provides a vision of desired outcomes and outlines a roadmap for how these outcomes are to be achieved. In such a framework, the vision of NFE would have to be broad-based and all-encompassing and within the overall framework of lifelong learning. Accreditation frameworks for the integration of NFE and formal education would have to be worked out, particularly because at present in many countries these frameworks are either weak or non-existent and NFE is marginalized. Also, a gender equity perspective would have to inform policy formulation to ensure that women as well as men have equal access to ICT and ICT-supported education programs, and gender concerns are addressed at all stages or phases of such programs.

A second factor for success of ICT-supported NFE is providing technology infrastructure and ensuring access. ICT-based non-formal literacy programs have often suffered from inadequate infrastructure and technical support. This was highlighted in a study on the use of ICT in education in seven of the E-9 countries (Bangladesh, Brazil, Egypt, India, Mexico, Pakistan, and the People's Republic of China) undertaken by UNESCO (UNESCO 2006). The study recommended that the Literacy Decade should be considered as an opportune time for policymakers to set up the required infrastructure — for example, phone lines, reliable electricity supply, and connectivity.

While CLCs are regarded as a viable strategy for giving rural communities access to ICT, there is a need for innovative and cost-effective ways of broadening access to prevent the exclusion of marginalized communities. Women's access to ICT is a major problem in some communities. ICT should be located in local institutions that poor women feel they can access without difficulty or restriction (Dighe and Reddi 2006).

Landlines and desktop computers are available in multipurpose community access centres (e.g. telecentres, schools), but there are difficulties in making them available in poor communities. Ongoing development of low-cost technologies is a key to provide ICT for the poor. Currently, Wireless Fidelity (WiFi) promises to provide low-cost broadband 'last mile' connectivity in densely populated areas and wireless mobile text messaging is spreading in a range of countries and commercial

and public service uses. Research, development, and piloting of low-cost technologies amenable to poor communities would need ongoing support, particularly from social and commercial entrepreneurs.

A third factor in the success of ICT-supported NFE programs is to make them people-driven rather than technology-driven. Case studies undertaken in different countries of the region demonstrate this. Often, however, there is a tendency to invest in technology without making a parallel investment in people. According to Reddi (2004), 'the bulk of the investment in any project generally goes toward overhead costs and few resources are left for project activities. A parallel investment in people, in good quality social research and community mobilization and involvement, rarely takes place.'

A process of de-mystification of technology has to take place so that poor people can begin to understand how technology functions and the possibilities it has to offer. This process cannot be rushed and people's pace of learning has to be respected. This has particular relevance for women as they would first need to get over the perception that technology is for men and not for them. It would be necessary for women to feel comfortable with technology, for they are likely to be hesitant in adopting new technology unless they can begin to use technology to respond to their needs.

The impact of ICT also depends on attitudes, expectations, organizational climate, and management styles. It is possible that intermediary organizations implementing ICT projects are hierarchical and bureaucratic in their style of functioning. Any hands-on experience in the use of technology can become a major hurdle in such organizations, and overcoming resistance and negative attitudes is a challenge that has to be overcome. The bottom line is that the focus of ICT-supported NFE programs has to be on people, on organizations and processes, and not just on technology.

Effective planning and program design is the fourth factor in the success of ICT-supported NFE. There is a need to take stock of existing infrastructure and to plan for hardware and software possibilities, taking into account connectivity, affordability, and capability. Equally important is the need to understand the existing information systems of the poor before ICT is introduced. There is a need to understand how ICT and culture intersect, because cultural factors can be a hindrance to ICT adoption in rural areas. This is particularly true for women. Green (2004) therefore advocates that great care be taken to ensure gender-sensitive program design.

Community participation in planning and designing ICT-supported interventions is vital. Experiences in many countries of the region have shown that ICT projects are more useful and sustainable when communities support and commit to them. However, it is important to recognize that communities are not homogenous and they are often divided along class, gender, and sectarian lines. It is necessary to ensure sustained and ongoing consultations with members of the community, particularly the poor members and women among them, to enable them to help make crucial decisions with regard to physical location, timing, and the use of ICT. The poor benefit from ICT when they know and control the technology and related know-how. Rather than simply *giving* the poor access to information, project designers and implementers should *listen* to the 'voice' of the poor in various decision-making processes.

Capacity-building and training comprise the fifth success factor in ICT-enhanced NFE. There is a need to train NFE functionaries, program administrators, and support staff. Moreover, it is necessary to provide skills training programs of various kinds to ensure that the poor use ICT effectively. Malaysia's experience has shown the importance of organizing training in basic computer use so that the rural communities are not left behind in the nation's ICT development process. Such training programs need to be organized on an ongoing basis to ensure operational use of ICT as well as their maintenance and upkeep by the members of the community. This would help instil a sense of ownership among the community.

Women would require gender-sensitive training and ongoing support. Women trainers have been found to be effective in training other women because aside from passing along skills, women trainers also serve as role models.

In addition, the potential of ICT for enhancing and supporting professional development of non-formal education, literacy and development personnel, planners, administrators, and educators should be explored.

A sixth factor for success in ICT-supported NFE is the development of content that is relevant to the learners. ICT can play an important role in stimulating interest and engaging learners, and it can be a useful tool in developing learning materials that are culturally and linguistically appropriate. One such literacy course offered by a CMC in the Madurai district of Tamil Nadu, India enables learners to create their own personalized content using digital cameras, computers, presentation software, and CD-ROMs. The successful experiences of many countries using technologies like television, radio, and video have shown that even 'low tech' devices can be very useful in creating a literacy conducive environment (UNESCO 2006), with women, for example, using these technologies in creative combinations with traditional media such as folk songs, dance, and theatre for self-expression and communication.

A seventh factor for successful ICT-supported NFE is planning for sustainability. Because their operating costs tend to be high, most ICT projects tend to close down as soon as the project funds are used up. It is therefore essential to address the problem of sustainability at the planning stage itself. The 'user pays' model is the default strategy for generating income for operations and maintenance. However, this business model tends to marginalize the poor, particularly the women among them, because they cannot afford to pay the user fees. Partnerships among stakeholders that will draw on the strengths and assets of various groups and ensure the coordination of efforts of various institutions, ministries, and organizations could address this problem.

Ensuring multi-stakeholder partnerships is the eighth factor for success in ICT-enhanced NFE programs. In such partnerships, the principal role of the government would be to facilitate the creation and equitable diffusion of infrastructure and the adaptation and scaling up of successful pilot projects. In addition, the public sector should provide the lead through strong policy interventions and substantial public investment (Gurumurthy and Singh 2005). The private sector could play an important role in supporting development of content and applications in the local languages. NGOs could partner with the government to ensure the participation of various disadvantaged groups, and to facilitate capacity-building.

The ninth factor for successful implementation of ICT-supported NFE programs is continuous monitoring and evaluation. The literature on ICT-supported development in general tends to be anecdotal and descriptive and there is a paucity of data from well-designed evaluation and research studies. While this is changing, it bears emphasizing that there is a need to undertake honest stock-taking of what worked and what did not work and for what reasons. Formative evaluation is necessary to identify the problems or stumbling blocks so that timely corrections can be taken to ensure that the objectives of the ICT project are met. Considering the multi-dimensionality of non-formal education, an interdisciplinary research approach would be useful to understand the complexities of ICT for NFE projects. Ethnographic action research (Tachhi et al. 2003) has been found to be useful in understanding the information needs of the poor in specific contexts.

THE CHALLENGES AHEAD

In concluding the meta-survey of ICT integration in education in the Asia Pacific region, Farrell and Wachholz (2004) aver that although the majority of countries in the region are still in the early stages of adopting ICT tools in educational systems, the situation is changing rapidly. A shift is taking place from donor-supported, NGO-led, small-scale, pilot projects to systemic integration informed by national government policies and multi-stakeholder-led implementation processes. However, what is disconcerting is that these changes are taking place in the school sector only and the spin-offs in the non-formal sector are not as evident.

The costs associated with setting up ICT infrastructure are forcing many governments to make difficult choices. For most national governments, the priority is primary education. Ironically, the pressure to achieve EFA goals could be forcing a number of national governments to sideline the education of out-of-school youth and non-literate adults. Similarly, the pressure to produce the necessary human capital for a 'knowledge-based' economy is resulting in greater investments being made in formal higher education systems.

While governments worldwide have signed up to the UN goal of a 50 percent reduction in illiteracy by 2015, actual investments in the programs that will deliver these goals are abysmally small. Torres (2002) laments that there is a mismatch between rhetoric and practice even among the international agencies as the 'expanded' and 'renewed' visions proposed in all of the major recent international declarations and commitments — in basic education (EFA 1990), adult education and learning (CONFINTEA V 1997), and literacy (UN Literacy Decade 2002) — tend to remain on paper and are contradicted by the same international agencies that promoted them and that provide technical and financial assistance to the South.

But since a significant proportion of the population in developing countries is out of school and without the literacy skills that will enable them to contribute to economic and social development, governments ignore the non-formal education sector only at their own peril. To develop a cohesive society, increase national competitiveness, and achieve sustainable growth and development, governments need to put in place NFE programs that focus on developing social capital among marginalized communities (Lizardi 2002). Non-formal educational programs for youth and adults should become one of the global priorities of our time.

For this to happen, the formation of alliances among stakeholders across all sectors is vital. The Global Campaign for Education, a coalition of NGOs and trade unions working in over 100 countries for the right to free, good quality education for all, is attempting to play an advocacy role. The hope is that multi-sectoral partnerships and alliances will create a groundswell that can influence national governments and international agencies to honour their commitments, and ignite a global movement that will make quality education truly a right for all.

NOTE

1. Rogers (2004) places much greater value on informal learning which for him is not always unintentional (as previously understood), but which is a natural activity that is continuous and highly individualized and contextualized. It is mainly through informal learning, rather than formal or non-formal learning, that a whole range of perceptions, attitudes, and skills are developed.

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Capacity-building for ICT integration in education

Wai-Kong **Ng**, Fengchun **Miao**, and Molly **Lee**

INTRODUCTION

Over the last decade or so, governments in the Asia Pacific region have been promoting the use of the new information and communication technologies (ICTs) in education. The nature of this ICT take-up goes beyond using information and communication systems to improve education administration, to large-scale adoption of digital technologies that is impacting on curricular and pedagogical structures. A confluence of economic, social, and political challenges accounts for this development. For one, there is pressure for governments to provide education to all members of the population — even in the face of scarce financial, physical, and human resources — as a precondition for economic and social development. At the same time, globalization and the shift to a 'knowledge-based economy' require that educational institutions develop in individuals the ability to transform information into knowledge and to apply that knowledge in dynamic, cross-cultural contexts. ICTs are a means for meeting these twin challenges. ICTs can improve access to and promote equity in education by providing educational opportunities to a greater number of people of all ages, including the traditionally unserved or underserved (e.g. those in rural and remote areas, women and girls, and persons with disabilities). Second, ICTs can enhance the quality of teaching and learning by providing access to a great variety of educational resources and by enabling participatory pedagogies. Third, ICTs can improve the management of education through more efficient administrative processes, including human resource management, monitoring and evaluation, and resource sharing.

However, ICTs are not a panacea or cure-all for gaps in education provision. The right conditions need to be in place before the educational benefits of ICT can be fully harnessed, and a systematic approach is required when integrating ICTs into the education system. This fact is often overlooked and, in their eagerness to jump on to the technology bandwagon, many education systems end up with technologies that are either not suitable for their needs or cannot be used optimally due to the lack of trained personnel. Vendor persistence oftentimes overshadows calm and logical consideration of any new technology to be adopted. For example, in Malaysia, it has been pointed out that '[o]ver-dependence on vendors and lack of monitoring are causing the (Malaysian) Government millions of ringgit for the rollout of various ICT initiatives' (*The Star* 2008). In the Philippines, the fixation with technology is demonstrated by the fact that the bulk of funding for ICT in schools projects goes to hardware and very little goes to teacher training (Arinto 2006).

This technocentric perspective on ICT in education is both a cause and an effect of the lack of capacity in ICT in education planning and implementation. In the first place, there is lack of capacity to systematically plan for ICT adoption. This in turn gives rise to failure to adequately provide for building the capacity of schools and education personnel to use ICT to improve teaching and learning. Thus, there is often poor implementation of ICT projects in schools.

This chapter focuses on the need to build capacity in ICT integration[1] among policymakers and teachers in developing countries in Asia Pacific. While there are other sectors and stakeholders in ICT in education programs, policymakers and teachers have a particularly important role to play in ICT integration. Policymakers[2] shape a country's education policies, including policy on who shall be educated, what they shall be educated about, and how they shall be educated. With respect to ICT in education, policymakers set the framework and make high-level decisions covering all aspects of program implementation. Teachers, on

the other hand, implement education policy. In ICT in education programs, teachers are 'the key to whether technology is used appropriately and effectively' (Carlson and Gadio 2002, p. 119).

The chapter is divided into two parts. The first part presents the basic elements of systematic and holistic ICT in education policy formulation and strategic planning that policymakers need to know. These principles constitute the basic framework for an ICT in Education Toolkit for policymakers and planners designed by the United Nations Educational, Scientific, and Cultural Organization — Asia and Pacific Regional Bureau for Education (UNESCO Bangkok), Knowledge Enterprise LCC, the Academy for Educational Development (AED), and *info*Dev/World Bank. The second part of the chapter focuses on what teachers need to know to be able to teach effectively with technology, and what this implies for the design of teacher professional development programs, including policy on teacher training in ICT integration. The ICT Competency Standards for Teachers released by UNESCO in early 2008 is also presented. The chapter aims to provide an overview of issues of concern in capacity-building in technology integration that might be of relevance to Asia Pacific countries.

POLICY CONSIDERATIONS IN ICT INTEGRATION IN EDUCATION

In 2003, UNESCO Bangkok conducted a meta-survey of the state of ICT use in education across Asia and the Pacific. Not surprisingly, the survey found a great deal of variation in the nature and extent of technology integration in the more than two dozen countries surveyed. Specifically, 'countries are at different stages of both development and implementation in the areas of policy formulation, ICT infrastructure development and access to it, content development, programme initiatives and the training provided for education personnel' (Farrell and Wachholz 2003, p. 265). The differences arise not only from differences in the countries' financial and human resources, but also from differences in policymaking with regard to ICT in education. Farrell and Wachholz (2003, p. 267) sum up these policy-related differences as follows:

> [T]he countries are arrayed along a continuum of stages with regard to policies pertaining to the integration of ICT into their education systems. While all of them have stated that the development of ICT capacity is important to the future of their countries, fewer have grappled with the policy questions as they relate to ICT applications in education — and many of those that have lack the resources to implement their strategies, a recurrent theme throughout the reports. *This 'lack of resources' reflects, however, weaknesses of existing policies and the need to improve them.* (italics supplied)

Indeed, weaknesses in policymaking often lead to the misallocation of resources, which in turn exacerbates the existing lack of resources. For example, there is a tendency to emphasize the installation of ICT over the seamless integration of ICT in teaching and learning — i.e. making ICT a part of the educational milieu and ensuring that it results in improved learning outcomes. This results in an 'incredible influx of financial support for equipment but only a meager trickle for network support or staff training' (Monahan 2004, p. 373).

In planning for ICT integration in education, policymakers would do well to begin by determining the educational purposes that technologies are to serve before they are brought on board. This means clarifying overall education policy, as this should serve as the rationale and road map for technology integration. It is important to note that technology is only a tool and as such cannot compensate for weaknesses in education policy. (Guttman 2003; Haddad 2007a)

Once national education goals have been clarified, policymakers need to decide on what ICT integration approach to adopt. Farrell and Wachholz (2003) found three different approaches being used in Asia Pacific countries: *(i)* teaching ICT as a subject in its own right, usually beginning at the upper secondary level, to develop a labour force with ICT skills; *(ii)* integrating ICTs across the curriculum to improve teaching and learning; and *(iii)* using ICTs to foster learning anywhere and anytime as part of the development of a knowledge society in which all citizens are ICT savvy. Each of these has different infrastructural, personnel, and management requirements, among others.

The key considerations in selecting infrastructure and hardware are appropriateness, cost-effectiveness, and sustainability. (Guttman 2003; Haddad 2007a). Appropriateness refers to fitness for purpose and context, which implies that policymakers must resist the pressure to adopt the newest technologies simply because they are 'high-tech' and other countries are adopting them. As Guttman (2003, p. 66) reminds us, 'some of the greatest educational problems are in the most remote areas, where electricity supplies may be irregular or non-existent, telephones scarce and lines difficult to maintain.' Policymakers need to be mindful that ICT does not become a source of further inequality, with the digital divide deepening existing disparities.

At the same time, in ensuring universal access to technologies, governments must keep in mind the need to ensure sustainability, which is technological, political, and social dimensions aside from the economic or financial dimensions. Technological sustainability has to do with choosing technology that will be effective over the long term, taking into account the rapid evolution of technologies and the availability of technical support. Political sustainability has to do with the policy environment and management of the change processes involved in technology integration in schools. Social sustainability comes

from the involvement of all stakeholders, including those who will use the technology (teachers, learners), those who will be affected by its use, and others with a legitimate interest in education processes (such as parents, political leaders, and business and industry leaders) (Tinio 2003).

The financial cost of ICT acquisition in schools is usually a major focus of attention in policymaking and project planning. But the cost of acquisition is only one aspect, and policymakers and administrators need to budget for the recurring costs that form part of the Total Cost of Ownership (TCO). Maintenance and support account for about a third to half of the initial investment in computer hardware and software (Haddad 2007b). Thus, even if computers may be acquired for free, as in the case of donated computers, they require a substantial financial investment for maintenance and support.

The development of content for ICT-supported teaching and learning is another key policy area. According to Haddad (2007b, p. 58), 'introducing TVs, radios, computers, and connectivity into schools without sufficient curriculum-related ICT-enhanced content is like building roads but not making cars available, or having a CD player at home when you have no CDs. Development of content software that is integral to the teaching/learning process is a must.' Policymakers will need to make a choice between acquiring or creating new ICT-enhanced educational content and software. Suitability (including curriculum relevance), availability, and cost are key considerations in making this choice. And the selection of appropriate content and software has to be made not once but many times, since different learning contexts will have different requirements, for example in terms of age and learning abilities, subject-specific demands, and culture and language.

The need for trained personnel who will implement technology integration in schools is also a key area that policymakers

need to pay attention to, and they must do so from the outset. Technology by itself is not enough to transform education processes and improve educational outcomes. As Haddad (2007b, p. 60) puts it, 'appropriate and effective use of technologies involves competent, committed interventions by people. The required competence and commitment cannot be inserted into a project as an afterthought, but must be built into conception and design[ed] with [the] participation of those concerned.' Capacity-building for teachers is especially crucial and will be discussed in the next section.

All of the key components of ICT integration in education discussed above will need to be integrated into a coherent plan with clearly specified targets, timelines, and costs. Moreover, the plan should first be implemented in pilot mode rather than full scale, in order to determine whether the various elements work singly and in combination. The pilot implementation has to be closely monitored and the evaluation results used to modify the plan for full implementation. The latter requires even more careful planning, and the implementation itself needs continuous monitoring and evaluation so that implementation problems are detected and addressed in a timely manner. It is only through systematic monitoring and evaluation that the educational effectiveness of ICT interventions can be determined (Haddad 2007b).

Different countries will formulate different policies regarding how best to harness the power of ICTs to further their economic and social development goals through education. Even the process of developing policy will differ among countries. However, the ICT in education policy considerations outlined above comprise a basic set of elements that can guide the policymaking process, and that policymakers can use to gauge the information and resources they need in the policymaking, project planning, and project implementation process. In the ICT in Education Toolkit (see 'A Toolkit for Decision Makers') that

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A Toolkit for Decision Makers

The ICT-in-Education Toolkit was developed by the UNESCO — Asia and Pacific Regional Bureau for Education (UNESCO Bangkok) in partnership with Knowledge Enterprise LCC, the Academy for Educational Development (AED) and *infoDev*/World Bank, 'to assist education policymakers, planners and practitioners in the process of harnessing the potential of ICTs to meet educational goals and targets efficiently and effectively.' It consists of six toolboxes of interactive instruments and step-by-step guidelines that help users to:

- Map the national, technological, and educational situation;
- Formulate and assess ICT-enhanced programs;
- Plan for physical and human requirements;
- Plan for ICT-enhanced content;
- Generate program costs;
- Create a master plan; and
- Monitor implementation, effectiveness, and impact.

The toolkit also contains a Reference Handbook that summarizes international knowledge, research, and experience on the effective use of ICTs in education. Figure 7.1 shows the structure and main components of the toolkit:

Figure 7.1

ICT in education toolkit for policymakers, planners, and practitioners

A₇ ICTs for Education: A Reference Handbook

| Decision Makers' Essentials | Analytical Review | Resources | PowerPoint Presentation |

Toolbox 1: Mapping of Present Situation

| Tool 1.1 Mapping of National Vision, Goals and Plans | Tool 1.2 Mapping of Educational Context | Tool 1.3 Mapping of ICTs in Education | Tool 1.4 Analysis of Dynamics for Change |

Toolbox 2: Development of an ICT-enhanced Program

Tool 2.1: Identification of Educational Areas for ICT Interventions

Tool 2.2: Formation of ICT Policy Interventions

Planning for Implementation

Toolbox 3: Planning for Physical and Human Requirements

| Tool 3.1 Infrastructure | Tool 3.2 Hardware | Tool 3.3 Personnel Training |

Toolbox 4: Planning for Contentware

Tool 4.1: Contentware Requirements

Tool 4.2: Identification and Evaluation of Existing Contentware

Tool 4.3: Exploring the Web for Educational Content

Tool 4.4: Evaluation of Course Authorship and Management Systems

Tool 4.5: Design, Development, and Testing of Curricular Contentware

Toolbox 5: Planning for Implementation: Summation

Tool 5.1: Cost and Finance

Tool 5.2: Master Plan

Toolbox 6: Assessment and Subsequent Actions

Tool 6.1: Evaluation of ICT Interventions

Tool 6.2: Adjustment and/or Scaling Up

(Source: *info*Dev/World Bank 2007)

> While the toolkit provides a set of analytical, diagnostic, and planning tools that can impose a certain discipline on the decision-making process, it does not provide the 'solutions' or 'answers' to the thorny issues in policymaking and decision-making. It also does not substitute for the political/organizational process of formulating policy. Instead, it encourages teams to work together on the issues identified and to coordinate human resources to come up with appropriate ICT-supported interventions in education.

UNESCO Bangkok is using in its capacity-building program for policymakers and program implementers in Asia Pacific countries, these elements are referred to as the 'parameters necessary for the potential of ICTs to be realized in knowledge dissemination, effective learning and training, and efficient education services' (Haddad 2007a, p. 11).

CAPACITY-BUILDING IN ICT INTEGRATION FOR TEACHERS

Even with a coherent and detailed policy and careful planning, ICT integration in education is a complex and protracted process. Various studies in both developed and developing countries point to four broad stages of ICT adoption and use that educational systems and individual schools typically go through (see Figure 7.2).

The experiences and behaviours of teachers and learners learning how to use ICTs can be mapped on to the four stages (see Figure 7.3).

At the first stage, teachers and learners are discovering ICT tools and their general functions and uses, and the emphasis is usually on ICT literacy and basic skills. Discovering ICT tools is linked with the *emerging stage* in ICT development.

The second stage involves learning how to use ICT tools, and beginning to make use of them in different disciplines. This involves the use of general as well as particular applications of ICT, and it is linked with the *applying stage* in the ICT development model.

At the third stage, there is understanding of how and when to use ICT tools to achieve a particular purpose, such as in completing a given project. This stage implies the ability to recognize situations where ICT will be helpful, choosing the most

Figure 7.2
Stages of ICT integration
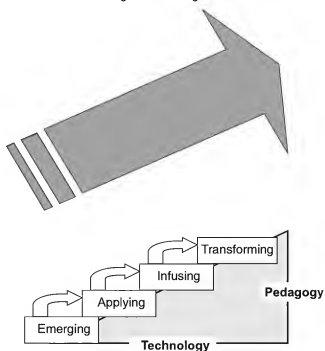
(Source: UNESCO Bangkok 2005)

Figure 7.3
Mapping teaching and learning to the stages of ICT integration

Specializing in the use of ICT   **Transforming**   Embedding LMS and WBI

Understanding how and when to use ICT   **Infusing**   Infusing multimedia and simulation

Learning how to use ICT   **Applying**   Integrating CAI/CBT/CAL

Becoming aware of ICT   **Emerging**   Using presentation software

(a) Based on usages   *(b) Based on delivery medium*
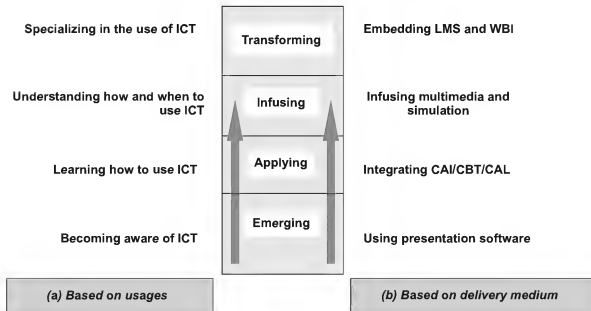
(Source: UNESCO Bangkok 2005)

appropriate tools for a particular task, and using these tools in combination to solve real problems. This is linked with the *infusing stage* in the ICT development model.

The fourth stage is when the learning situation is transformed through the use of ICT. This is a new way of approaching teaching and learning situations with specialized ICT tools, and it is linked with the *transforming stage* in the ICT development model.

Progression through the stages takes time. And the transformation of pedagogical practice requires more than ICT skills training for teachers. Too often the approach taken to teacher training in ICT integration is the one-off crash course on computer literacy. This approach does not enable teachers to integrate ICT in their day-to-day activities and master the use of ICT as an effective tool for teaching and learning. A 2004 study by UNESCO Bangkok of ICT integration experiences across six countries in Asia reports the following 'lessons learned' with respect to approaches to teacher training in ICT integration:

- Training teachers on ICT-related skills within the context of classroom objectives and activities ensures the development of skills in the integrated use of ICT in teaching.
- School-based training of teachers by their more experienced peers from other schools or senior instructors from the MoE (Ministry of Education) ensures that teachers are trained in the context of their workplace.

- Needs-based just-in-time learning and peer coaching ensure further development of teachers' ICT and pedagogical skills.

A school-based and classroom-focused approach to teacher training in ICT use takes into account the fact that teachers need to 'learn about technology ... in the context of their subject matter and pedagogy' (Hughes 2004, p. 347). Teachers learn how to use ICTs more effectively when they see the technologies not as generic and decontextualized tools but as tools for teaching, that is, for motivating, managing, facilitating, enhancing, and evaluating learning (Otero et al. 2005). Teachers also need 'to see a direct link between technology and the curriculum for which they are responsible' (Gadio and Carlson 2002, p. 122). As the UNESCO Bangkok (2004, p. 104) study puts it, 'When teachers perceive ICT as a tool to meet curricular goals, they are more likely to integrate ICT in their lessons.'

Thus, teacher training in ICT integration needs to be hands-on, involving the application of skills learned (through formal training) in the classroom over an extended period of time. This in turn means that the teachers need access to technology resources (computers, training materials, educational software), support from technology managers (i.e. the computer lab manager or ICT coordinator), and support from colleagues and school administrators. The latter play a pivotal role in ICT integration in schools, as they are in a position to inspire a shared vision for comprehensive technology integration and 'foster an environment

and culture conducive to the realization of that vision' (TSSA Collaborative 2001).

Part of fostering an environment that is supportive of learning how to teach effectively with technology is implementing an incentive system and motivational strategies for teachers. According to Carlson and Gadio (2002, p. 122):

> While so-called 'champion teachers' ask for and seek out professional development opportunities in the use of technology, the vast majority of teachers do not. Teachers generally are reluctant to change their teaching styles and habits; are cautious of time-consuming activities that may take away from other high-priority obligations (economic, familial, or educational); have difficulty seeing the potential payoff beforehand of this kind of training; and may feel so threatened by technology that they want to distance themselves from it rather than embrace it. Put simply, many teachers require additional motivation and incentives to participate actively in professional development activities.

Providing teachers with access to technology resources within the school *post* training is one motivational strategy. Having them work with colleagues in technology-supported instructional design projects is another (UNESCO Bangkok 2004). Giving teachers time and recognition for innovation is essential. Teachers need to be given time to participate in training activities and they need to be given time to try out what they have learned in the classroom. The latter means that school administrators should take care not to overload teachers particularly with extra-curricular assignments — although perhaps this is easier said than done in the majority of public schools in developing countries where there is a shortage of teachers. Teachers who successfully complete professional development programs and implement technology-supported teaching and learning innovations should be given public recognition to give them a sense of achievement and encourage them to continue, as well as to encourage others to participate in such programs (Carlson and Gadio 2002).

An important incentive for teachers to upgrade their knowledge of and skills in ICT integration is formal certification of in-service professional development leading to a degree (UNESCO Bangkok 2004). Action on this point clearly goes beyond the school level and even the district or schools division level, to the level of the Ministry or Department of Education, since it is the latter that should certify teacher training programs.

More generally, because national imperatives for ICT integration in education, and the consequent increase in the demand for teachers to be skilled in ICT use in teaching and learning,

Ministries of Education need to adopt a new framework for teacher professional development (TPD) that reflects a shift from 'training' to 'lifelong professional preparedness and development of teachers'. This framework specifies the following components of TPD (Carlson and Gadio 2002; Haddad and Draxler 2002):

- Initial preparation/training or pre-service education that builds a solid knowledge base of teaching, consisting of knowledge of content (subject matter) and the curriculum; instructional approaches and strategies, including assessment; classroom management and organization; learners and their characteristics; educational contexts, purposes, and values; and the use of educational technologies.
- Structured opportunities for retraining, upgrading, and acquisition of new knowledge and skills in-service, including workshops, courses, and postgraduate certificate and degree programs.
- Continuous support for teachers as they undertake their day-to-day work.

This TPD continuum requires that there be closer coordination between those involved in pre-service and in-service teacher education. It also implies the need for capacity-building in ICT integration for teacher educators in pre-service teacher education institutions. This is because like schoolteachers, most teacher educators, even in developed countries, are ill-prepared to teach with the new ICTs (Russell et al. 2003).

This new TPD paradigm, which is based on a broad understanding of what teachers (and learners) need to know and how they learn in a rapidly evolving knowledge society, should inform moves by education authorities and policymakers to adopt competency standards for teachers in ICT integration. For one, such standards should go beyond technology literacy or the ability to use hardware and software, to include how technology impacts teaching and learning (and vice versa). Second, such standards should not be imposed on teachers as requirements or rules to comply with, but instead given as guidelines for developing appropriate TPD programs in ICT integration. This distinction is important especially where the policy environment and implementation frameworks and systems for ICT integration are not fully developed or well established.

A model that integrates the various dimensions of building the capacity of teachers to teach effectively with technology is UNESCO's ICT Competency Standards for Teachers (ICT-CST). These new guidelines are intended for teachers and TPD providers, including Ministries of Education, as a *planning* tool that can then be used to assess levels of attainment during TPD program implementation. The guidelines recognize that the identification of ICT competencies for teachers should be framed

by a clear understanding of a country's overall approach to ICT use in education. Different countries could adopt one of three approaches: *(i)* to develop a technology-literate workforce to enhance national economic productivity and competitiveness; *(ii)* to develop knowledge workers, or individuals who can apply knowledge to add value to the economy and society; and *(iii)* to develop innovators and knowledge creators for the knowledge society. Each of these implies different educational policy directions and modes of organization and practice (see 'ICT Competency Standards for Teachers').

CONCLUSION

As governments in the region embark on large-scale adoption of ICTs in education, it is important to move away from technocentric planning and implementation approaches to models that focus on establishing sound policy and support strategies leading to capacity development and empowerment (Uimonen 2004).

For this to happen, policymakers themselves need to develop their capacity in holistic and systematic policy formulation and strategic planning for ICT integration. While they do not need to know the nuts and bolts of technology, policymakers need to understand how technologies and education systems

interact. They need to have a good grasp not only of the potential benefits of technologies for education, but also of the conditions necessary for ICTs to be effective in educational contexts and the process of educational change.

A sound policy and holistic plan for ICT integration recognizes the critical role that teachers play in ensuring the appropriate, effective, and sustainable use of ICTs to provide quality education for all. Thus, such a policy and plan give priority to teacher professional development that empowers teachers not just to implement but also to *lead* educational innovations that will transform schools and ultimately, all of society.

NOTES

1. The term 'technology integration' refers to 'the use of computers and the Internet to support teaching and learning across the curriculum' (Gaible and Burns 2005, p. 18). In this chapter, the term is used interchangeably with 'ICT integration'.

2. Policymakers include *(i)* politicians who are senior members of government and members of parliament; *(ii)* senior administrators in ministries and government agencies; *(iii)* personnel in senior positions in national associations representing various interest groups; and *(iv)* academics serving as consultants or staff members for the first three groups (Postlethwaite 1985).

ICT Competency Standards for Teachers

In January 2008, UNESCO launched an ICT Competency Standards for Teachers (ICT-CST) to provide a common set of guidelines that professional development providers can use to identify, develop, or evaluate learning materials or teacher training programs in the use of ICT in teaching and learning; and a basic set of qualifications that allows teachers to integrate ICT into their teaching and learning, to advance student learning, and to improve other professional duties. The ICT-CST also aims to extend teachers' professional development to enable to use ICT to develop skills in pedagogy, collaboration, leadership, and innovative school development; and to harmonize different views and vocabulary regarding the uses of ICT in teacher education.

The ICT-CST reflects a three-stage model of ICT integration in education based on the idea that education reform supports national economic and social development in one of three ways, namely:

1. by developing technology literate citizens and workers through the incorporation of technology skills in the curriculum (the technology literacy approach);
2. by developing citizens and workers who can apply knowledge to solving complex, real-world problems and thus add value to society and the economy (the knowledge deepening approach); and
3. by developing citizens and workers who can innovate and produce new knowledge (the knowledge creation approach).

At various stages of development, different countries would espouse one of these three approaches to educational change, and this will be reflected in their policy goals and visions. Moreover, each approach impacts on five other components of the education system, namely, curriculum and assessment, pedagogy, ICT (technology use), school organization and administration, and TPD.

Figure 7.4
UNESCO ICT competency standards framework for teachers

POLICY AND VISION	TECHNOLOGY LITERACY	KNOWLEDGE DEEPENING	KNOWLEDGE CREATION
CURRICULUM AND ASSESSMENT	BASIC KNOWLEDGE	KNOWLEDGE APPLICATION	21st CENTURY SKILLS
PEDAGOGY	INTEGRATE TECHNOLOGY	COMPLEX PROBLEM SOLVING	SELF-MANAGEMENT
ICT	BASIC TOOLS	COMPLEX TOOLS	PERVASIVE TOOLS
ORGANIZATION AND ADMINISTRATION	STANDARD CLASSROOM	COLLABORATIVE GROUPS	LEARNING ORGANIZATIONS
TEACHER PROFESSIONAL DEVELOPMENT	DIGITAL LITERACY	MANAGE AND GUIDE	TEACHER AS MODEL LEARNER

(Source: UNESCO 2008)

The technology literacy approach is the simplest. Its policy goal is to prepare students, citizens, and a workforce that is capable of using ICTs to support social development and improve economic productivity. TPD programs that are coordinated with this policy aim to develop teachers' skills in using basic ICT tools in delivering the standard school curriculum. Such teachers would know how, where, and when (and when not) to use technology for classroom activities and presentations, for management tasks, and to acquire additional subject matter and pedagogical knowledge in support of their own professional development.

The knowledge deepening approach has a greater impact on learning. Its policy goal is to increase the ability of learners, citizens, and the workforce to add value to society and the economy by applying knowledge to solve complex, real-world problems, such as those related to the environment, food security, health, and conflict resolution. This policy goal requires curricular changes to emphasize depth of subject matter understanding and application. Under this approach, teachers will need to develop skills in the use of more sophisticated methodologies and technologies that will enable them to serve as a guide and manager of the learning environment and enable students to engage in extended, collaborative project-based learning activities.

The knowledge creation approach is the most complex. Its policy goal is to increase civic participation, cultural creativity, and economic productivity by developing students, citizens, and a workforce that is continually engaged in knowledge creation, innovation, and participation in the learning society. Thus, the curriculum goes beyond a focus on knowledge of school subjects to explicitly include the 21st century skills that are needed to create new knowledge and engage in lifelong learning — i.e. the ability to collaborate, communicate, create, innovate, and think critically. TPD under this approach would coordinate the teachers' increasingly sophisticated professional skills with the pervasive use of technology to support students who are creating knowledge products and who are engaged in planning and managing their own learning goals and activities. This takes place within a school that is, itself, becoming a continuously improving, learning organization. In this context, teachers both model the learning process for students and serve as model learners through their own ongoing professional development.

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Public-private partnerships in ICT for education

Hitendra **Pillay** and Greg **Hearn**[1]

INTRODUCTION

A recent World Bank report notes that across the world, per capita economic growth is driven by three information and communication technology (ICT)-related factors: investments in equipment and infrastructure, investments in human capital (i.e. in education and innovation), and efficient use of labour (human resource) and capital that increases productivity (Schware 2005). These three factors have a direct impact on the provisioning of education. For one, the demand to adopt ICT-supported education services, or e-education, is outweighing the capacity of governments to adequately support education reform and expansion.[2]

At the same time, these three factors are key areas of interest to the private sector, which includes local, national, and international private commercial enterprises, non-government organizations (NGOs), not-for-profit trusts, philanthropic organizations, and development agencies. This interest and support from the private sector can be leveraged to enable the sharing of resources to overcome such obstacles as limited funds and lack of technical expertise and project management capacities in ICT integration in education.

Public and private enterprises associated with e-education projects are driven by different agendas, which results in divergent targets and bottom lines. However, they may share common 'development' interests in having educated and healthy citizens, in putting in place the physical and social infrastructure that would improve the quality of learning, and in expanding markets for sustainable growth of e-education. A sharing of resources between public and private enterprises in e-education interventions make possible a shift away from collective, tax-based financing of educational infrastructure and services.

Moreover, it is assumed that when public and private partners join forces to improve the provision of e-education services their complementary strengths can accelerate the pace of progress. Such partnerships draw in new ideas and capacities for problem-solving and leverage investments and professional expertise. Thus, the sum of the partnership wields greater influence, touches more people in need, and reaps benefits for all participants. The experience of Organisation for Economic Co-operation and Development (OECD) countries shows that public-private partnerships (PPP) can play a vital role in mobilizing the scale of resources required for financing and building ICT infrastructure, developing applications and locally relevant content, and developing the human capacity required for harnessing the full capacity of ICT productive tools (Ichiro and McNamara 2003).

NATURE AND SIGNIFICANCE OF PPP

PPP in the education sector is not a new concept. The private sector has been involved in different ways and at various levels in the provision of education services. Two definitions that capture the essence of PPP are as follows:

- 'risk sharing relationships based upon an agreed aspiration between the public and private sectors to bring about a desired public policy outcome' (Commission on UK Private Public Partnerships 2008).
- 'a cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly

defined public needs through an appropriate allocation of resources, risks and rewards' (Canadian Council for Public-Private Partnerships 2008).

The central tenet of PPP is shared ownership of the project, which means sharing of risks and rewards. Thus the importance of a mutually conducive partnership agreement cannot be over-emphasized. In general, most PPP frameworks may be shaped around the following concepts:

Effectiveness	• Success in meeting the PPP objectives • Effectively managing and monitoring the delivery of the program • Scalability/replicability
Efficiency	• Return on investment analysis • Affordability (public sector support) • Developing and implementing a regulatory mechanism
Equity and political considerations	• Equity (access for poor and rural populations) • Political/trade union resistance • Contingent on wider public sector reform
Sustainability	• Economic returns to the private sector (within the medium to long term) • Financing risk (within a long-term arrangement) • Private sector appetitive and capability • Local stakeholders buy-in

Between fully public sector enterprises and fully private enterprises, there is a continuum of PPPs (see Figure 8.1): managed contracts, lease agreements, joint ventures, build-operate-transfer schemes, build-operate-own schemes, and concession agreements. A totally privatized venture would not have any shared responsibility with the public sector; it is a case of full divestiture to the private sector and thus can no longer be considered a PPP.

The perceived commercial potential of providing public services is often associated with the significant market power of the public sector given that it may be the only provider of such services and the consumers do not have choices. The return on investment for the private sector partners may be achieved directly through fee for service, government concessions, or combinations of both. In the case of philanthropic private partners, the return could be non-monetary, such as ensuring a healthy, prosperous, and empowered community.

The different modalities, the number of partners and their roles, and the nature of service sought can affect the level of risk in the partnership. For instance, PPP enterprises in large countries like China, India, and Indonesia can be formed at the federal and state government levels with the federal government forging agreements with the state government, which in turn has agreements with private providers. These multi-layered PPPs seek enhanced outreach capacity through the NGO networks that are often more effective and efficient in delivering public services to the grassroots. It allows the public sector to utilize the strengths of different government entities and NGOs to become more responsive to local demand.

Being negotiated agreements, PPPs are not always straightforward. There must be careful consideration of the medium- to long-term impact of PPPs, as many of the issues may not be readily apparent at the time of negotiations. PPP arrangements can vary across a risk-reward spectrum in terms of planning and design, construction/development, implementation/performance, operating costs and capacity, variation in revenue and demand for service, technology obsolescence and limited expertise, and terminal and residual risks. The partners should separately undertake a risk assessment using a detailed 'risk allocation matrix' (see Appendix 8.1A). The risk assessment should be realistic and risks should be calculated for the medium- and long-term. Usually, the greater the risk, the more return the private sector partner will expect before signing up to a PPP agreement.

Figure 8.1
PPP modalities
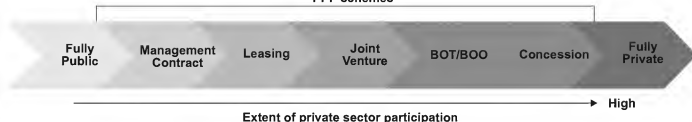
(Source: The National Council of Private Public Partnerships 2000)

Risks tend to be greater when dealing with ICT in education due to the rapidly changing technology, continuous curriculum reforms, ever increasing competition, and intangible and uncertain returns on investment. Thus private partners are often very cautious in entering PPPs for ICT integration in education. For the public sector the important thing to consider is the level of risk transfer that can be achieved through the PPP.

USING PPP IN ICT-SUPPORTED EDUCATION AND TRAINING

The 2007 Global Knowledge Conference recognized the need to invest in human capacity development in many Asia Pacific countries to enable them to implement ICT initiatives in general and e-education initiatives in particular. Projections of demand for online learning by investment firms such as IDC, Merrill Lynch, and WR Hambrecht & Co., all indicate exponential growth in the future[3] (Varoglu and Wachholz 2001). This rapidly unfolding demand has emerged alongside an increased responsiveness from the private sector to engage in the development and delivery of education services and products. Traditional models of provision for education and training can no longer meet the demand, opening up opportunities for PPPs both at the national and transnational levels.

Partnerships with private providers of education services have had mixed reactions. Issues of national sovereignty and cultural values, equity and access, quality, and relevance of content to local needs, among others, have been raised and they need to be addressed via a good regulatory framework. Opening up the market to national and transnational providers also has implications for the survival of local providers, as the larger national and transnational providers have the advantage of economies of scale.

Despite these concerns, however, PPPs have become more significant, largely because of the huge capital costs and new types of expertise associated with e-education interventions. Given that e-education has cross-sector, national, and transnational implications, it is important to consider partnerships both within a local and broader framework. For transnational PPPs, the World Trade Organization (WTO) General Agreement on Trade in Services (GATS) could provide national authorities some guidance in the development of a regulatory framework for opening up and managing education markets to national and international private providers.

PPPs can be forged for various aspects of e-education provision as discussed here.

PPPs for Infrastructure and Equipment

E-Education is dependent on having good infrastructure and high-quality connectivity. Because these are often expensive to acquire and maintain, governments are increasingly turning to private partners for assistance in national infrastructure development. The following are examples of ways in which PPPs may be applied to infrastructure investments.

In a joint venture, the government jointly invests in developing information technology (IT) infrastructure with private sector partners and either jointly runs the project with the private sector or outsources the management of the infrastructure with caveats in place to ensure equity and quality of service provision. All partners share the risks and rewards on an agreed basis. To ensure that access to the IT infrastructure is available at fair market value, the government puts in place a sound regulatory and policy framework. For example, the Australian federal government has allocated AUD 4.7 billion to build a national broadband network based on joint public-private funding. The private partner is expected to provide access to its existing IT network, and technical and management capacity to expand the network coverage to include the rural areas and also invest financially. The initiative is intended to allow rural schools, farmers, and other regional communities to participate in global knowledge sharing.

In other types of joint ventures, notably private finance initiatives, capital investment is made by the private sector on the strength of a contract with government to provide agreed services. Government contributions in this case may be in kind only, for example providing a guarantee for the loan or assisting the private partner to leverage venture capital on the strength of the association with the government.

In seeding capital, governments provide capital for initial infrastructure development with an expectation that the private partners (both local and foreign) will further develop the infrastructure as the demand grows. Some Asia Pacific countries have opted for this type of partnership. Examples include the Malaysian Multimedia Supercorridor, the Hong Kong government's HKD 100 million venture capital, and the Bali Camp software development houses. These initiatives have had varied success due to differences in regulatory capacity and the availability of qualified human resources. The Malaysian initiatives have now been extended to the Smart School project, which intends to connect all schools through an education sub-network.

Governments also seek funds and technical expertise from international donor agencies to invest in innovative pilot projects

that, if successful, become PPP models for scaling up. But one of the risks in donor-led pilot projects is that one can easily become dependent on the propriety software, technology, and content provided by some of the private sector partners during the pilot stages. Such software, technology, and content may not be the best cost option or be the most relevant to local needs in the long term. Thus, as donor funding ends, pilot projects often fail as there are no agreed exit strategies to ensure continued resourcing.

In leasing and contracting arrangements, government and private enterprises enter into agreements for the use of ICT resources to implement public education policies. Typical lease agreements are for: (i) data hosting and storage spaces, where secure systems that can withstand natural disasters (such as hurricane force winds and floods) and have a backup power supply are key considerations; (ii) access to certain bandwidth on networks to ensure an optimum speed at all times; and (iii) supply of equipment such as computers and other digital equipment with minimum specifications. Many equipment lease agreements have a time-based (3–5 years) equipment upgrade requirement to keep pace with continuous technological and software innovations. One of the biggest risks in entering into a leasing agreement is not sufficiently considering the implications of regular maintenance of the equipment and the quality of service (e.g. factoring in network down times). This should be discussed during the negotiation stage.

Another common lease agreement can be seen in initial attempts to privatize public telecommunications assets. In these cases a private enterprise may lease the public infrastructure and manage the delivery of necessary public services for an agreed fee.

PPP for the Provision of Educational and Professional Training

The increasing demand for education in general and higher education and continuing education in particular cannot be met by the current model for delivering education and training systems. PPPs are an alternative model.

Online ICT skills training: An example of PPP in training is the Cisco Academy, which provides online training through partnerships with public and private institutions or universities that they designate as Learning Solutions Partners or Cisco Learning Partners. The public institutions either integrate the Cisco training within their programs to increase the relevance of their programs and increase student enrolments, or provide space, for a fee, to deliver the training. Online training is also provided by Indian company Aptech in partnership with the Indian Technical and Economic Co-operation (ITEC) as part of a Government of India initiative to provide software design and applications training to local and international participants from a range of sectors, including education. Aptech has also initiated the India Window Program where foreign students and corporate executives are trained in information technology and multimedia in India and participate in a mandatory internship at IT firms in Bangalore, the 'Silicon Valley of India'. These skills training partnerships provide courses that are driven by specific industry demands and have globally recognized credentials. They enjoy a high status, unlike regular distance and online education programs. But this cannot be said of all transnational online programs, and national and global online training partners have to

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Intec Partnership to Promote ICT for Education

Intec is a private IT company in Mongolia providing direct services to private companies. It also serves as a project partner in many public sector projects financed by international donor agencies.

Intec has partnered with Atos Consulting of the United Kingdom (UK) to provide IT expertise to the Information and Communication Technology Authority (ICTA) of the Government of Mongolia (GoM). The partnership pooled the collective expertise of all of the partners to review the e-government strategy of the GoM and give the ICTA recommendations on how to pursue the e-government strategy to be implemented through a PPP model.

Intec has also partnered with Aptech WorldWide to set up a centre in Mongolia that will deliver a two-year software engineering course to fee-paying students and demand- and needs-based IT training courses to private commercial companies and government organizations. The Aptech WorldWide Mongolia Center (http://www.aptechmongolia.edu.mn/) is currently discussing with the GoM the possibility of providing custom-built training for ICTA staff. It has also partnered with the Ministry of Education, Culture and Science (MECS) of Mongolia to pilot the Aptech Plus — IT Training for Secondary School program. The pilot will provide the MECS feedback about whether to formally adopt Aptech Plus content in its secondary schools.

The Intec website is at http://www.itconsulting.mn/index.htm.

be carefully scrutinized for quality (see 'Intec Partnership to Promote ICT for Education').

Corporate online training: The flexibility and cost-efficiency of developing and delivering e-education and training, which traditionally has been the role of universities and IT vendors, has caught the interest of large multinational private organizations. These companies are forming 'concession' partnerships to jointly develop and deliver training on new equipment, software, and use of productive tools to public and private organizations. Hewlett-Packard has estimated that it saved USD 5.5 million on training 700 engineers (Hall 2000), and IBM saved USD 200 million in one year by delivering its management development program online (Horton 2000). The Ford Motor company, which operates in 125 countries and six continents, has adopted the e-education services provided by the Ford Learning Network for all training and staff development needs. Lessons from these private sector initiatives have also been adopted for the training of senior managers and technical staff in the public sector, mainly with private vendor companies.

In Asia Pacific countries, the base-level ICT capacity of senior managers, the turnover of staff with ICT capabilities within the public sector, and the peculiarities of individual government agencies can vary significantly. Thus, forging PPP agreements for customized training services on a long-term basis can be very attractive.

University partnership networks: As the significance of ICT is realized, more universities are teaming up with leading ICT companies, such as learning management system (LMS) developers, professional associations and corporate organizations, to jointly develop and deliver new e-education programs. Partnerships for the use of TV and radio for education already exist in countries like China, India, Pakistan, and Thailand. The challenge now for Asia Pacific universities is to use integrated IT platforms for the delivery of university courses. In the West, using IT platforms to jointly develop and deliver training can be seen in the US army forming a partnership with universities in creating a unique e-learning program called 'eArmyU'. The program allows soldiers to take classes from 32 US universities while working locally or overseas (Voth 2003).

There are also joint research and development (R&D) programs for complex learning management systems, multi-media tools for developing complex simulations and analysis, and course content development.

PPPs supporting university research particularly in the medical sciences, including pharmacy, IT and energy, are common and are likely to increase with the emergence of grid computing, which is largely driven by the private sector. The grid computing paradigm[1] provides access to high-quality video conferencing facilities, large-scale distributed meetings

and collaboration, and synchronous interactive sessions from multiple locations for research seminars, lectures, tutorials, and training. High-performance computing capacity for digitization, visualization, animation, and mapping has revolutionized research and communication while nanotechnology innovations have increased efficiency in data processing and storage. These technological innovations have the potential to enable large-scale resource sharing and to bring people, computing systems, and information resources together through collaborative partnerships between private and public sector research and education enterprises. To enhance their global research and knowledge innovation capacities, universities can form partnerships not only with other universities through university consortiums but also with private sector partners.

The development of Open Access (www.openj-gate.com) as a means of disseminating findings from government-funded research is being supported by Informatics India, a private enterprise. Similar research databases serving the mutual purposes of universities and the private sector exist in the West. In addition, public sector initiatives like the Australian Research Council's industry linkage[5] scheme provide a facility through which university and private sector partners can engage in joint research, including in ICT innovations.

These research agreements are concession partnerships where limited public funds are provided by the public sector and the private sector partner matches the funding through a mix of cash and 'in-kind' contributions. The intellectual property produced or developed is often shared between the university(ies), the private sector partner(s), and the researchers. Indeed it is not uncommon for private companies to tap university professors and students, as well as university infrastructure, in product or applications development. When Microsoft first introduced its Tablet PC, it funded a research trial use of the machine. But in this case the partnership is closer to a contract and the intellectual property is owned by Microsoft.

PPP for e-Education and Social Development

The focus of e-education for social development is building social capital and improving the quality of life of disadvantaged communities by giving them access to information, empowering them to have a voice in how they live and work, encouraging them to participate in the knowledge economy, opening up opportunities for women to improve their social and economic status, and stimulating local business and marketing opportunities. Several international donor and philanthropic agencies have forged partnerships with governments, NGOs, and commercial enterprises to support e-education for social development.

Different partnership models, such as seeding funds, build-operate-transfer, and joint venture schemes, have been used for ICT service delivery to rural and remote telecentres, village information centres, community multimedia centres, information kiosks, and telecottages. The outcomes have been varied. One of the main concerns is the tenuous nature of the partnerships and the question of sustainability. International donors and philanthropic agencies often fund pilot projects but leave to the local partners the challenge of successfully transforming a pilot initiative into an institutionalized function within the community and attracting ongoing support. The transformation is often expected to happen within unrealistic timeframes. There is a need to adopt a long-term approach to seeking buy-in from local stakeholders and thereby ensure sustainability. Shifting to a sustainable model may be particularly difficult in countries that do not have a generous private sector to work with and where the average community incomes may be below poverty levels. Thus, the risks associated with community-based e-education partnerships need to be assessed at the outset.

Despite these difficulties, some PPPs supporting ICT interventions at the community level appear to have matured and have now moved beyond ICT learning centres. They are now seen as providing core information for the daily activities of a community such as local market opportunities or information on health epidemics, agricultural development, and weather forecast, and connecting people subjected to internal migration for economic reasons or due to natural disasters. Many of these community-based ICT centres are becoming consolidated social and information hubs. In many countries the success of some of these NGO-led interventions has been recognized and they have been mainstreamed into the national education system and are now supported through the national budget.

Partnerships between international donor agencies, private companies, and NGOs have also been supporting local content creation. For example, 'Finding a Voice' (http://www.findingavoice.org/) is a research partnership jointly funded by the Australian Research Council, UNESCO India, and UNDP Indonesia, and being implemented by researchers from the Queensland University of Technology and several NGOs from Nepal, India, and Sri Lanka. The project works with grassroots communities to develop ICT skills in generating local content. Aside from developing computer and multimedia skills, these kinds of projects deliver integrated education services for farmers, fishermen, and other community folk on topics that are relevant to them, such as public health, parenting, and nutrition (ADB and ESCAP — Economic and Social Commission for Asia and the Pacific — 2004).

Many governments in the Asia Pacific region have led initiatives for connecting rural and remote areas. For instance,

the federal and state governments of India have entered into a multi-level partnership to include rural and remote communities in the digital economy. The Indian government has established partnerships with NGOs and not-for-profit trusts to deliver its ICT education programs to rural and remote areas. The partnership leverages the strength of NGOs in working with grassroots communities, which is critical for the success of this initiative. The Indian government plans to establish some 2,500 ICT community centres that will not only provide ICT learning opportunities but also act as the delivery point for government services.[6]

Some NGOs with support from public funding have forged partnerships with commercial private sector partners to provide ICT training to the underprivileged. Project Saraswati for IT Literacy and Project Srishti for Multimedia Training, for example, provide free training for underprivileged children at various Aptech, Arena, and SSi centres.

PPPs with telecommunication corporations with a strong commitment to social development can be pursued in advancing technological innovations, such as wireless broadband, 3G, and Fixed Mobile Convergence (FMC),[7] with the potential to significantly reduce user costs and increase access to information and knowledge. The Grameen Telecom Corporation in Bangladesh, for example, has the Village Phone Program, which provides universal access to telecommunications services in remote, rural areas. A partnership between the government's rural development programs and the Grameen Telecom Corporation provides subsidized connectivity to rural and remote villages using more cost-effective technologies such as 3G and wireless.

PPP in ICT for Basic Education

Preparing citizens for the knowledge society will be most effective if e-education is introduced at the basic education level. However, this sub-sector attracts limited interest from the private sector, particularly where the public sector aim is to provide access to education for poor and rural children as part of a policy of universal basic education. This is because the last mile of connectivity tends to be expensive, with little commercial return. Most ICT implementation partnerships in this sub-sector are government-led, such as those found in Australia, Malaysia, and Singapore. In some countries, the interventions are government-led, but in partnership with international donor agencies or vendor companies. These types of partnerships are not mutually exclusive and sometimes it may be an advantage to merge or combine them.

The most common type of agreement is 'seeding fund' partnerships with emphasis on front-end costs and mostly capital

costs. However, such an approach tends to underestimate the total cost of ownership (TCO) of computers and other ICT equipment, which includes recurrent costs such as ongoing hardware maintenance and upgrades of hardware and software in addition to initial capital outlays. Also, teachers have to devote additional time and effort to learning new skills in content development, approaches to teaching, and methods of assessment.

An important aspect of private sector participation involves contributions 'in-kind' of networking equipment, PCs, and concessional access to software licences for an initial period, as well as ICT skills training for teachers and students. For example, Microsoft has partnered with many states throughout India to provide free basic technology training to teachers of state-funded schools. This includes 'The Innovative Teachers Forums' that encourage innovative teachers to adopt ICT, award best practices in ICT integration, and support teachers in building global communities of practice (see 'Microsoft Innovative Schools Program').

International agencies such as the Asian Development Bank and the World Bank have also invested in providing ICT to the basic education sub-sector. Some of these initiatives have involved setting up computer labs in schools, computerizing education administration through Education Management Information Systems (EMIS), and developing an e-curriculum with appropriate learning materials. Other initiatives have set up 'schoolnets' and school-based telecentre projects where school children use the ICT facility during school hours and the community uses the facility for a fee after hours to generate an income that can help offset the centre's operating costs. Most of these are initially partnerships between the government and donor agencies but with the expectation that the community will take over the responsibility of ensuring sustainability once donor support ends. However, as mentioned, the transition has been difficult for many projects particularly in low-income communities.

NGOs also enter into partnerships with governments to promote ICT integration in basic education. For example, the US-based World Links for Development plans to work with state governments in India to bridge the digital divide by training secondary schoolteachers in 125 Indian schools in classroom applications of ICT. It will also provide school connectivity, basic computer literacy, and professional development training to teachers. Further support for PPP can be seen in the public–private alliance that is drawing together educational innovators and technology leaders to improve the quality of teaching, motivate children to complete school, and ensure that the skills of young people meet the needs of India's emerging economy. The Quality Education and Skills Training Alliance (QUEST), a partnership between Indian and American technology corporations with NGOs supported by public funds and working within the basic education system, is targeting the needs of marginalized children using ICT-supported non-formal education as the medium.

Technological innovations, which in turn facilitate the development of more advanced learning materials, have also triggered partnerships. The Singapore-based ICT company Litespeed

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Microsoft Innovative Schools Program

The Innovative Schools project is part of the Microsoft Partners-in-Learning Initiative (PiL) launched in 2004.[8] Following four pilot projects in Singapore, Taiwan, the UK, and the US, this PPP scheme was extended to 12 locations, including three schools in Singapore and seven in Hong Kong. A local program manager, the Microsoft team, and a working group mentor work closely with the selected schools to formulate a blueprint employing the 6 'i' development processes — introspection, investigation, inclusion, innovation, implementation, and insight — developed in the School of the Future project.

The objectives are to partner with governments, schools, teachers, and technology partners to assist primary or secondary schools in strategic planning and furthering innovation in learning and knowledge discovery, and to equip students with the right skills to meet the demands of a knowledge-based economy. Microsoft provides not direct funding but access to technology solutions, human capital in terms of technology expertise, and knowledge in resources planning, curriculum development, and research findings from other projects such as School of the Future and BackPack.NET. The schools raise their own funding for building the infrastructure and acquiring the appropriate equipment, software, and technologies. After two years, evaluations at the school and program level are conducted by an independent third party research organization.

(Source: Microsoft 2009)

(http://www.litespeed.com.sg/) is a partnership between Ngee Ann Polytechnic, Hewlett-Packard, and SNP panpac that is developing a Diagnostics Tutorial Assessment System (DTAS) and Intelligent Content Assessment Marking (ICAM) system with the potential to revolutionize general education assessment practices. This partnership has also worked with schools and teachers to develop customized e-learning content. Litespeed has entered into partnerships with Education authorities in Hong Kong, Malaysia, and Singapore to provide an integrated e-education platform for schools.

CONCLUSION

In the past few years global initiatives such as the Digital Opportunity Task Force,[9] the Global Knowledge Partnership, the UN ICT Task Force,[10] and the World Summit on the Information Society have significantly increased awareness of the vital role that international cooperation can play in providing access for all to ICT as a tool for economic and social development. They have established multi-stakeholder partnerships, such as the Global Digital Opportunity Initiative (GDOI),[11] as a mechanism for developing creative PPPs and mobilizing private sector interest in supporting ICT for development and education.

There are challenges to confront. On one hand, the private sector is less interested in financial assistance to the education sector than in the profitability of the demand for its products and services in the long run. On the other hand, demand for the new access devices to the Web, new broadband networks, and new social networking applications such as blogs, wikis, and music and video sharing, and the increasing availability of educational content for online learning are becoming a part of global education and learning services. This demand and growth has the potential to generate more interest from the private sectors and provide alternative ways to mobilize community interest and action toward furthering PPP in the education sector.

From a national perspective, e-education is an important strategy for adapting the workforce to the technological revolution. It is also a tradable service with no boundaries. Education for all is a real possibility for the first time in human history and PPPs have the potential to make a significant contribution to delivering this reality.

Perhaps the most challenging task for governments in Asia Pacific countries will be the development of a sound understanding of what is entailed in PPPs and the creation of conducive environments for sustaining the interest of both public and private partners. Knowledge, skills, and expertise in developing, negotiating, implementing, and monitoring projects and programs with partners that may have competing agendas are crucial for the success of PPPs in ICT for education.

NOTES

1. The authors would like to acknowledge the contributions of Professor John Ure of Hong Kong University to earlier drafts of this chapter.

2. In many countries in the Asia Pacific region a substantial part (85–90 percent) of the education budget is spent on salaries alone and very little is left for capital investments such as those required for ICT interventions.

3. This demand is not just in the formal education sub-sector but also in non-formal education/community development and continuing professional development of employees.

4. The Grid Computing Information Centre (http://www.gridcomputing.com) 'enables the sharing, selection and aggregation of a wide variety of geographically distributed computational resources (such as supercomputers, computer clusters, storage systems, data sources, instruments, people) and presents them as a single, unified resource for solving large-scale data intensive computing applications. This idea is analogous to electric power network (grid) where power generators are distributed, but the users are able to access electric power without bothering about the source of energy and its location.'

5. This is an Australian Federal Government initiative to bring together industry and universities to undertake innovative research in Australia, including in the ICT software, hardware and service delivery areas.

6. See the chapters on China, India, and Pakistan in this volume for further information on government-led PPP for e-education.

7. In FMC a single handset can switch seamlessly between making calls over cellular and Wireless Fidelity (WiFi) networks.

8. Other initiatives under PiL include the Innovative Teachers program and Innovative Students program. The Innovative Teachers program consists of an Innovative Teachers Network which provides educators with access to teaching tools through a network of portals and Innovative Teachers Forums, which recognize teachers who demonstrate best teaching practices. The Innovative Students program offers software package at more affordable price than commercial rates.

9. The Digital Opportunity Task Force (www.dotforce.org) was set up and launched by the G8 member countries at the G8 Kyushu-Okinawa Summit in 2000.

10. The UN ICT Task Force (www.unicttaskforce.org) was created by the Secretary General in 2001 at the request of the UN Economic and Social Council.

11. The Global Digital Opportunity Initiative (www.gdoi.org) is a partnership of the UNDP and the Markle Foundation to engage public and private institutions and individuals to help developing countries formulate a comprehensive national approach, including resource allocation for specific ICT solutions.

APPENDIX

No	Nature of risk spectrum	Definition of risk type	Allocation		
			Public sector	Private sector	Shared
1.	**Design risk**				
1.1	Failure to design to agreed brief	Failure to translate the required products and services into a viable project design with an agreed time frame		✓	
1.2	Amendments to meet requirements of the public sector	The public sector partner may require changes to the design, causing additional design and construction costs	✓		
1.3	Untenable design due to external influences	Need for a design change due to legislative and regulatory or technical and material unavailability etc.			✓
2.	**Construction and development risks**				✓
2.1	Unrealistic schedule and time estimate	Not considering all factors in estimating the time required to complete the construction may result in significant extensions that can incur additional costs			
2.2	Unforeseen site conditions	Accelerating the process, resulting in the private sector being unable to carry out necessary surveys prior to commencing work either because facilities are currently occupied or access to the site is not possible	✓		
2.3	Third party claims	Costs associated with third party claims, such as loss of amenity, livelihood, ground subsidence on adjacent properties	✓		
2.4	Force majeure	Additional costs are incurred; facilities may also be unavailable or parties may no longer be able to deliver as per the contract	✓		
2.5	Industrial action by contractor/ sub-contractor	Industrial action may cause construction and implementation activities to be delayed, as well as incur additional management costs		✓	
3.	**Performance risks**				
3.1	Change in specification initiated by the public sector	During the operating phase of the project, the public sector procuring the services could require changes to the specification	✓		
3.2	Performance of sub-contractors	Poor management of sub-contractors can lead to poor coordination and under-performance by the contractors. This may create additional costs in the provision of services		✓	
3.3	Default by contractor or sub-contractor	In the case of default by a contractor or sub-contractor, there may be a need to make emergency provisions. There may also be additional costs involved in finding a replacement		✓	
3.4	Termination due to force majeure	A force majeure could mean the parties will no longer be able to meet their contractual obligations	✓		

No	Nature of risk spectrum	Definition of risk type	Public sector	Private sector	Shared
			Allocation		
4.	**Operating cost risks**				
4.1	Incorrect cost estimates for providing services under the contract	The actual cost of providing these services may be different from the projected cost due to unexpected changes in the cost of equipment, labour, utilities, and other supplies		✓	
4.2	Legislative/regulatory changes having capital cost consequences	Changes to legislation/regulation may lead to additional construction costs, and higher building, maintenance, equipment, or labour costs			✓
4.3	Change in taxation	The scope and level of taxation will affect the cost of providing services	✓		
5.	**Variability of revenue risk**				
5.1	Non-performance risks	Payment will only be made by the public sector for services received		✓	
5.2	Poor performance of services	The operator will incur deductions from the performance payment for poor performance of services		✓	
5.3	Changes in the volume of demand for services	The volume of demand for the product and services may change during certain periods or due to demographic changes caused by internal migration	✓		
6.	**Termination risks**				
6.1	Termination due to default by the public sector	The public sector defaults on its non-financial commitments, leading to contract termination and no compensation for the private sector	✓		
6.2	Default by the operator causing financiers to step in	The operator or individual service providers default and financiers step in, leading to higher costs than agreed in the contract		✓	
7.	**Technology and obsolescence risks**				
7.1	Changes to technology; assets prematurely becoming obsolete	The building, plant, and/or equipment may become obsolete before the project is completed and commissioned		✓	
8.	**Residual risk**				
8.1	The public sector no longer requires the assets at the end of the contract	The procuring entity might wish to vacate the asset at the end of the contract period, and the operator may be faced with decommissioning costs	✓		

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Part C
Sub-regional perspectives

Pacific Island Countries

Asia-Pacific Economic Cooperation

Association of Southeast Asian Nations

South Asian Association for Regional Cooperation

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Pacific Island Countries

Arthur **Jorari**, John **Budden**, and Samuelu **Taufao**

OVERVIEW

The inhabited islands of the Pacific are spread over an area of about 30 million square kilometres and stretches from the Commonwealth of the Northern Mariana Islands in the North-West Pacific Ocean to Pitcairn in the South East. Estimates in Table 9.1 show that 82 percent of Melanesia, which accounts for 87 percent of the total population of the Pacific Island countries (PIC), live in rural areas and remote communities. In Polynesia, 62 percent of an estimated 650,000 live in rural areas while in the smaller Micronesia states, 34 percent of an estimated 546,000 are rural inhabitants.

The region is characterized by huge diversity in physical geography and culture, languages and socio-political organizations, size, and resource endowment. Some countries such as Nauru and Niue consist of just one coral island, whereas others like Papua New Guinea (PNG) and the Federated States of Micronesia (FSM) consist of hundreds of islands. Melanesia has large mountainous and mainly volcanic islands endowed with rich soil and abundant marine life. In contrast, Micronesia and Polynesia have mostly small atolls with poor soil and with elevations of between 1 and 2 metres (Kiribati, Marshall Islands, Tuvalu, and Tokelau). There are some islands of volcanic origin with more fertile land, such as Samoa, Tonga, the Federated States of Micronesia, and Cook Islands.

Although only 0.1 percent of the world's population live in the Pacific region, it is home to one third of the world's languages, which indicates enormous cultural diversity and substantial social, political, and behavioural complexities. This situation is most pronounced across Melanesia, with over 700 languages spoken in Papua New Guinea alone and more than 100 each in the Solomon Islands and Vanuatu. In Micronesia and Polynesia, one national language is the norm in most countries.

There are distinct differences in social organizations and cultural practices between the three broad sub-regions. For example, throughout Melanesia, social and political status and power are usually acquired on the basis of matrilineal, patrilineal, and individual merit and effort. In most of Polynesia, they are achieved on the basis of patrilineal descent. In Micronesia, the situation is more complex: on high islands and more fertile atolls, there are close similarities to the Polynesian system, whereas on the less endowed atolls, age plays a more prominent role, with political control traditionally exercised by councils of elders or chiefs.

Given these socio-cultural, biophysical, economic, and political complexities, it comes as no surprise to observe a rich socio-economic and demographic diversity in a regional population of just over 9.3 million people:

1. Of the total Pacific population, 68 percent live in Papua New Guinea. There is rapid population growth especially in the Melanesian and Micronesian countries, a high fertility rate, a declining population growth in some Polynesian countries due to out-migration, and an increasing influx of imported labour.

2. High population growth rates of over 2 percent annually are observed in five countries — FSM, Nauru, PNG, Solomon Islands, and Vanuatu. On the other hand, three countries — Cook Islands, Niue, and Tokelau — are observed to have a loose population, largely due to out-migration to New Zealand.

Table 9.1
Mid-2007 Pacific Island population estimates

Region/country or territory	Last census year	Population as counted at last census	Mid-year population estimate (2007)	Urban population (%)	Growth rate Urban (%)	Growth rate Rural (%)	Median age
MELANESIA			8,137,100	18.3	–	–	20.8
Fiji Islands	1996	775,077	831,600	46	2.6	–0.5	23.7
New Caledonia	2004	230,789	241,700	63	2.5	1.0	29.3
Papua New Guinea	2000	5,190,786	6,332,750	13	2.8	2.7	20.3
Solomon Islands	1999	409,042	503,900	16	4.2	2.5	19.7
Vanuatu	1999	186,678	227,150	21	4.0	2.2	19.9
MICRONESIA			545,900	66.2	–	–	24.2
Federated States of Micronesia	2000	107,008	110,600	22	–2.2	1.0	19.9
Guam	2000	154,805	172,300	93	1.8	–1.4	28.7
Kiribati	2005	92,533	95,500	44	1.9	1.8	21.3
Marshall Islands	1999	50,840	52,700	68	1.6	1.3	18.6
Nauru	2006	9,429	9,900	100	2.3	n.a.	21.0
Northern Mariana Islands	2000	69,221	84,700	90	3.7	2.3	29.2
Palau	2005	19,907	20,200	64	–1.0	4.4	33.2
POLYNESIA			649,650	38.2	–	–	23.1
American Samoa	2000	57,291	65,000	50	2.4	1.7	21.3
Cook Islands	2006	19,569	13,500	72	3.0	–1.5	26.3
French Polynesia	2002	244,830	261,400	53	1.5	2.1	27.8
Niue	2006	1,625	1,600	36	–1.1	–2.4	32.0
Pitcairn Islands	2005	50	50	–	–	–	48.3
Samoa	2006	179,186	179,500	21	–0.8	0.6	18.9
Tokelau	2006	1,151	1,200	0	–	–	22.8
Tonga	2006	101,991	102,300	23	0.5	0.4	21.0
Tuvalu	2002	9,561	9,700	47	1.4	–0.2	24.1
Wallis and Futuna	2003	14,944	15,400	0	–	–	24.5
TOTAL SPC COUNTRIES			9,332,650	22.5	–	–	21.2

(Source: SPC Statistics and Demography Programme 2007)

Rapid urban population growth rates of over 3 percent per year occur in the Solomon Islands, PNG, and Vanuatu. Urban population growth rates are increasing in the other countries, especially in PNG and Cook Islands. This leads to increasing rates of urbanization in many countries of the Pacific. Lack of services in rural areas is the main determinant of rural-to-urban or outer-island-to-main-island migration in many countries.

3. While out-migration contributes to declining net population growth, it impacts negatively on workforce development as increasing numbers of skilled and professional people leave the island nations in search of better education and employment opportunities. Out-migration negatively impacts on the productivity of all sectors, with health and education being the most affected, particularly in rural areas or outer islands.

4. The impact of increasing rural-to-urban migration on urban population growth in many countries, combined with poor urban planning, contributes to a range of social and economic problems in urban areas. Increasing urban population leads to rising rates of unemployment, squatter settlements and overcrowded dwellings, and it strains the capacity of government to provide basic services, such as housing, water, sanitation, electricity, health, and education services. Such situations contribute to substandard living conditions and poverty, and fuel other poverty-driven social problems such as crimes, robbery, lawlessness, substance abuse, sexual and domestic violence, and prostitution and HIV. Rural-urban migration is likely to continue if socioeconomic development is concentrated in urban and main islands only.

5. Persistent high urban population growth and overcrowding also has serious environmental consequences, leading to increased environmental degradation and contamination. The impact of climate change in Kiribati and Tuvalu has serious implications for development. Urgent attention is

needed for planning for basic needs such as food, housing, and water.

6. At the current rate of population growth, the Pacific population is expected to double in 28 years. This relatively rapid population growth implies further pressures on land, stretched resources for services and infrastructure, and increasing unemployment. It does not allow room for national development to take place. Growing numbers of young people become bored and restless as they search for employment and aspirations beyond village-based agricultural and fishing activities.

7. The health status of the Pacific is challenged by a range of complex public health problems. Health determinants, risk factors, and morbidity and mortality patterns are changing rapidly; local capacity to respond is limited; progress has been slowed or reversed; and the delivery of health services and healthcare is expensive.

8. The number of women dying from pregnancy-related and delivery complications remains high in a number of countries, especially PNG and the Solomon Islands. In addition, the infant mortality rates are still high (over 50 infant deaths per 1,000 births) in Kiribati, PNG, and Solomon Islands. Life expectancy remains low: below 60 years in Nauru and PNG and between 60 and 64 years in Tuvalu and Kiribati.

9. All of these factors contribute to growing poverty, which gives rise to increasing social problems such as domestic violence; increasing rates of divorce and marital separations; early sexual activity among the youth that puts them at risk of sexually transmitted infection, HIV infection, and teenage pregnancies; and poverty-driven prostitution. Addressing these issues puts further pressure on the already diminishing resources of governments.

10. Poverty is a major factor that hinders socio-economic development. Studies by the Asian Development Bank (ADB) in 2004 reveal that at least 20 percent of households in 12 of 13 PICs suffer from basic needs poverty; the proportion of underweight children reaches 27 percent in some countries; and 20 percent or higher of the population is living on less than USD 1 a day in six out of nine Pacific countries.

11. Many school age children, especially in Melanesia, are not attending school due to the inaccessibility of schools, parents not being able to afford the costs of schooling, and lack of space in the schools (see 'Pacific Island Countries — The Struggle to Educate').

The challenges facing the PICs to improve livelihoods and services especially in the rural areas and remote communities are immense. Many national reports point to the lack of infrastructure,

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Pacific Island Countries — The Struggle to Educate[1]

Despite favourable developments in recent years, the educational performance of many PICs remains among the poorest among developing countries. For example, more than half of the estimated two million children in the 6–17 year age group are out of school. Over 90 percent of those not at school live in rural areas, remote communities, and outlying islands.

Table 9.2 summarizes actual population figures for age group 6–17 years from the latest available census data for PNG, Solomon Islands, Kiribati, Cook Islands, Nauru, Tokelau, Tonga, Tuvalu, Niue, Samoa, FSM, and the Republic of the Marshall Islands (RMI).[2]

For the 12 countries included in Table 9.2, 51 percent or about 933,900 of 1.82 million 6–17-year-olds are not at school. The figures are particularly startling for the bigger Melanesian countries such as PNG and Solomon Islands. For PNG, the 2000 census figures show that more than 57 percent of 717,500 6–17-year-olds never attended school. Similarly in the Solomon Islands, 124,000 (30 percent) of the total population make up the 6–17 year age group and about 37 percent of them are not at school. With only 16 percent of the total Solomon Islands population living in urban areas, it is highly likely that the proportion of 'not at school' population is much higher in rural areas and remote communities.

In Micronesia, the figures are equally alarming. For example, in 2005 almost three fifths (58 percent) of Kiribati's total population of 92,533 were below 25 years old. About a third (30 percent) is between 6 and 17 years old, with 13 percent not at school. Even the Polynesian countries with generally high literacy rates, such as Tonga and Samoa, have some challenges dealing with school dropouts and ensuring that school-age children have equal education and learning opportunities, regardless of their social status and geographic location.

Table 9.2

Population 6–17 years for selected PICs by status for school attendance

				Population: 6–17 years		
		Total			Not in school	
	Total population	population 8–17	In school	Total[b]	Dropout (P)	No schooling
Total[a]	**6,169,725**	**1,824,444**	**856,579**	**933,972**	**172,641**	**751,123**
Papua New Guinea (2000)						
Total	5,190,786	1,531,661	633,768	866,138	148,514	717,624
Male	2,691,744	809,779	340,105	452,645	77,548	375,099
Female	2,499,042	721,882	293,663	413,493	70,968	342,525
Solomon Islands (1999)						
Total	409,042	124,131	75,444	46,583	17,483	27,871
Male	211,381	64,840	40,128	23,358	8,716	13,985
Female	197,661	59,491	35,316	23,225	8,767	13,886
Kiribati (2005)						
Total	92,533	27,393	23,802	3,557	1,067	928
Male	45,612	14,027	11,822	2,192	718	576
Female	45,921	13,366	11,980	1,365	349	352
Cook Islands (2001)						
Total	18,027	4,200	3,641	559	11	205
Male	9,300	2,202	1,898	304	6	96
Female	8,727	1,998	1,743	255	5	109
Nauru (2002)						
Total	10,065	2,875	1,933	942	87	529
Male	5,136	1,514	991	523	62	304
Female	4,929	1,361	942	419	25	225
Tokelau (2001)						
Total	1,537	449	404	45	2	2
Male	761	231	204	27	2	2
Female	776	218	200	18	–	–
Tonga (1996–2006)						
(1996) Total	97,762	29,173	26,869	2,304	730	–
Male	49,611	15,258	13,904	1,354	420	–
Female	48,151	13,915	12,965	950	310	–
(2006) Total	101,991	28,928	27,331	1,597	632	231
Male	51,772	15,161	14,121	1,040	427	136
Female	50,219	13,767	13,210	557	205	95
Tuvalu (2002)						
Total	9,561	2,547	2,293	254	43	10
Male	4,729	1,363	1,187	176	30	4
Female	4,832	1,184	1,106	78	13	6
Niue (2006)						
Total	1,625	362	338	24	4	–
Male	802	195	178	17	3	–
Female	823	167	160	7	1	–
Samoa (2001)						
Total	176,710	51,491	47,668	3,823	798	320
Male	92,050	27,010	24,528	2,482	554	205
Female	84,660	24,481	23,140	1,341	244	115
FSM (2000)						
Total	107,008	33,801	26,542	7,259	1,934	2,639
Male	54,191	17,569	13,546	4,023	1,130	1,494
Female	52,817	16,232	12,996	3,236	804	1,145

(Table 9.2 continued)

		Population: 6–17 years				
		Total			Not in school	
	Total population	population 8–17	In school	Total*	Dropout (P)	No schooling
(Table 9.2 continued)						
RMI (1999)						
Total	50,840	16,606	13,415	3,191	2,066	764
Male	26,026	8,486	6,810	1,676	1,090	421
Female	24,814	8,120	6,605	1,515	976	343

Source: Latest population census of each PIC.
Note: +Tonga 1996 figures excluded from the totals.
       *Total includes those who droped out of high school and those with education status 'not stated'.
       (P) Dropped out after primary school.
       Data is difficult to obtain for the following countries — Fiji (1996), Vanuatu (1999), Palau (2000).

(Source: Jorari 2007)

essential services, basic hygiene, primary education, high service costs, and shortage of trained expertise and human resources as major hurdles. Reaching out to remote and rural communities is difficult. The advent of new technologies that are robust, low cost to deploy and operate, portable, and integrated with Internet connectivity provide opportunities that were not previously available. However, Pacific household-based population and housing censuses and survey results show that many households, especially in rural areas or outer islands, do not have access to information and communication technology (ICT).

THE ICT SECTOR

In general the ICT sector in most countries of the region is immature and underdeveloped. The problem starts with poor access to ICT — an issue noted by the Eminent Persons Group that formulated the parameters for the Pacific Plan's Digital Strategy — and extends to limited applications and lack of local content.

Only four countries (Fiji, Guam, New Caledonia, and PNG) have submarine fibre cable access to the global backbone for telephony and the Internet.

ICT penetration in country is concentrated mainly around the major population centres. In some countries with monopoly operators, such as FSM, French Polynesia, and New Caledonia, newer services such as Voice over Internet Protocol (VoIP), Wireless Fidelity (WiFi), and pre-paid billing have increased the customer base, reduced usage costs, and significantly lifted customer satisfaction. But for the majority of small island countries, low volumes using existing technologies and existing business models have meant high prices, which in turn have resulted in low uptake.

The low levels of access have hampered the development of government services, economic development, and social cohesion, and placed a brake on development of services.

The situation is set to change (and in some cases it has already changed) with the service and commercial options now offered by newer technologies and sector reforms being undertaken in many states with the assistance of the World Bank, International Telecommunication Union (ITU), Asia Pacific Telecommunity (APT), European Union (EU), and other agencies. Faster services such as broadband connections via Asymmetric Digital Subscriber Line (ADSL) and very small aperture terminal (VSAT) satellite are now being complemented by wireless mobile and Internet services in many business and community centres. New entrants and business partnerships are challenging the status quo. For example, Digicel South Pacific, which was launched in November 2006, claims to be the fastest growing mobile operator in the Pacific with current operations in Samoa, PNG, Tonga, Fiji, and Vanuatu). In addition, the recent availability of VSAT satellite services combined with 'wireless IP' and 'GSM in a Box' solutions to the last mile promise to revolutionize access for rural and remote communities (see 'Key Regional Initiatives').

However, the key to reform is an understanding for policy-makers of that telecommunications can have a huge multiplier effect on all aspects of the economy and society. For example, in FSM, which has a population of about 107,000 spread across four states in approximately 2.78 million square kilometres of ocean, the government-owned Telecom is able to provide basic fixed line telephony at USD 10.00 per month, including local calls and reasonably priced mobile phone services in all main business centres. Text messaging using mobiles is charged USD 0.04 per message. Internet access for the 5,000 wireless subscribers costs USD 0.08 per megabyte and for the 2,000 dial-up subscribers

USD 19.95 per month. All of these services can be paid using Telecom's pre-paid 'one-card billing system'. At current wireless Internet pricing, Telecom's services are considerably cheaper than in many countries, including Australia and New Zealand, and business people and tourists visiting FSM will find the place capable of providing them with reasonably good services to catch up with urgent work and family needs at home. What FSM lacks is good quality and cheap telephone services between the many different islands. But Telecom's capacity to address this looks promising, if coupled with government support to adapt new technologies and opportunities, such as those provided by low-cost, but robust SkyEdge VSAT terminals.

REGULATORY ENVIRONMENT AND FRAMEWORK FOR ICT

Until five years ago, the Pacific was served by monopoly (usually government or part government) telecommunication operators using Public Switched Telephone Network (PSTN) technologies. For historical reasons the tariffs had been allowed to drift into a very unbalanced basket with excessive international (and often long distance, mobile, and leased line) rates being offset by uneconomically low line rentals. Universal service obligation (USO) was ill-defined and the relevant authorities were not serious about monitoring the operators' level of commitment to their obligation. Furthermore, the USO was often used to justify the existence of a monopoly: it was alleged that the competition would 'cream skim' or provide services only to high-value or low-cost customers.

The entry of bypass operators and VoIP technologies was noted but the politically difficult increases in domestic rentals were often delayed or avoided, with the result that these so-called disruptive technologies are precipitating a crisis in cash flows and a reassessment of the USO. Statistics show that with the aggressive growth in Internet uptake, voice traffic in all countries is now just a small part of total usage. There has also been a spectacular increase in mobile phone usage. As new technologies such as General Packet Radio Service (GPRS) for mobile Internet are rolled out, operators still using older commercial models are being seriously challenged. They are finding it difficult to cope with declining revenues and how to tackle the steady inflow of new technologies such as VoIP.

Moreover, the regulators usually confined themselves to spectrum issues, and policymaking based on an understanding of the technologies and the implication of the dramatic effects of convergence and Moore's Law was almost non-existent. There was a general lack of vision on how ICTs could solve many of the issues facing islanders, including improving quality of education and healthcare, lubricating trade, and building and maintaining social cohesion.

Reforms in the last five years and the introduction of market competition in several countries have destroyed the myth that Pacific markets are too small or fragile for competition. The newer technologies are providing for more distributed solutions. While the natural monopoly still applies to copper and fibre, satellite and wireless with their scalability and flexible rollout are providing a choice in voice and increasingly in data.

The capacity to provide adequate regulation is still lacking, with the result that new licences, interconnection, and USO are often handled in an ad hoc and reactive manner. This has resulted in uncertainty in markets where the capital demands dictate a much clearer and stable environment. But there have also been some significant breakthroughs.

About three years ago, Samoa took concrete steps and appointed its first independent regulator. Since then, competition has seen major readjustments in the cost and quality of services. New entrant Digicel reports that their mobile telephony covers the whole country. SamoaTel, the incumbent operator with a monopoly on fixed telephony services, and the second mobile telephony operator have begun offering broadband Internet services, together with Computer Services Limited (CSL), the main Internet service provider (ISP). The government is serious about privatizing SamoaTel. This will enable the government to concentrate on its regulatory function to ensure fair and equal opportunities for all sector players. This is an attractive model for other island countries to consider.

In addition, as recently as early 2008, the Fiji interim government successfully negotiated opening up the telecommunications sector. The entry of Digicel into the Fiji market can provide very positive results for the Fijian populace as witnessed in Samoa since the issuance of new licences in late 2006. Even island countries with relatively small populations are proving that properly regulated competition can make a significant positive difference to the buying public and incumbent operators.

In PNG, the regulator PANGTEL has issued licences to new entrants, including Digicel. Although the current government prefers that the international gateway remain with the government-owned Telikom operator, it is undeniable that the implementation of competition and policy reforms are underway. The results include better quality of service and reduced costs.

The Pacific Plan Digital Strategy

In adopting the Pacific Plan in 2005, Pacific leaders identified ICTs as a powerful development and stabilization resource and called for a Digital Strategy to identify mechanisms to accelerate the development of ICTs in the region. Based on the

understanding that a mechanism for overcoming the undeniable lack of scale in the Pacific is regional solutions, the regional Digital Strategy establishes a broad roadmap of actions toward a regional digital society.

Starting with informed and decisive leadership, the Strategy calls for modern legislation, regulatory development, and the establishment of conducive investment climates based on policies that reflect the potential of ICTs. It supports the installation of new infrastructure and expanded access, and encourages the development of platforms, applications, and content to provide ubiquitous services in society, economy, and government.

Specifically, the Strategy:

- recognizes the potential role of broadcast media and the importance of developing application synergies (e.g. telephony, Internet, media, and 'add-ons' like disaster warning or environmental monitoring) to maximize the returns on infrastructure investments in sparsely populated areas;
- recommends where possible that regional synergies be exploited in collective purchasing and sharing of specialist expertise; and
- identifies the lack of human capacity in ICT in all areas as an inhibitor.

Since the Strategy was endorsed in 2005, the engagement of a wide range of stakeholders has been sought and obtained. They include Council of Regional Organizations (CROP) members,[3] the Pacific Islands Telecommunications Association (PITA), the Pacific Islands Chapter of the Internet Society (PICISOC), various United Nations agencies,[4] regional entities such as APT donors, and other members of civil society. Slowly a 'leadership model' is evolving.

The tensions between the old governance models and the new are being reflected in national and sector tensions. It is likely that a more loose, inclusive, bottom-up model akin to that of the Internet will emerge, replacing the more disciplined top-down model of telecommunications in the past. A balance between the orderliness and standardization that ensures interoperability in the top-down approach, and the vibrancy and creativity of the bottom-up approach, is being sought. This finds parallels in the rethinking of broader governance models that might be more appropriate to the Melanesian, Polynesian, and Micronesian cultural fabric.

ICT Ministerial Taskforce

The Meeting of Pacific Island Forum ICT Ministers in Wellington in 2006 developed a step ladder approach to the Digital Strategy. Starting with a request to benchmark the sector and the

development of country strategies, it also established a Task Force to advance some of the thrusts of the Digital Strategy, including identifying the regional synergies described above. The task force has formulated a regional regulatory resources support mechanism that has been put to donors and is likely to be implemented in late 2008. Work is in progress on collective purchasing of bandwidth. New initiatives on satellite and cable connectivity are also part of this process (see 'Key Regional Initiatives').

e-Readiness Survey

Much of the debate about digital access and digital opportunity misses the point that the root cause of lack of access and application is lack of coherent policies, lack of understanding about potential ICT-based solutions in government and commerce, and lack of ability to mobilize financial and human capacity to drive change. There is urgent need for a change in the current mindset that 'public services' must be totally managed and funded through government mechanisms. A step in the right direction is an e-readiness assessment using the Harvard Centre for International Development (CID) model being conducted in all 14 Pacific Forum island countries by a team of experts from various agencies. The results should be available in late 2008 or early 2009. This is an ongoing capacity-building and awareness exercise as much as a data-gathering exercise. It is also an attempt to supplement the leadership deficit alluded to above.

Regional Institutional Framework

To achieve efficiency in support delivery to small island countries, Pacific leaders have initiated a process to rationalize and consolidate agencies in the region in the form of a new Regional Institutional Framework. In the future, the Pacific Islands Forum Secretariat (PIFS) will limit itself to broad policy aspects of the economics of utilities. Moreover, the capacity of the Secretariat of the Pacific Community (SPC) to provide technical support and advice will be enhanced together with other key CROP agencies involved in ICT. This process will also seek to exploit the crosscutting nature of ICT and build on the potential of ICT to improve the efficiency and effectiveness of many other sectors and programs.

The Regional Institutional Framework is still a work in progress.

KEY REGIONAL INITIATIVES

Some key regional ICT projects currently managed by PIFS and SPC are the Rural Internet Connectivity System (RICS), South

Pacific Islands Network (SPIN), and One Laptop per Child (OLPC) projects. These are the more tangible initiatives directed at access, affordability, and enabling applications envisaged under the Pacific Plan. Involving both donors and government in collective endeavours, they form a backbone onto which the ICT society must be welded.

The RICS project uses the footprint and favourable link budget of an existing GE-23 satellite to enable access anywhere in the Pacific via VSAT. It uses small and 'cheap' 1.2m or 1.8m dishes and terminal equipment that require less power than for a laptop computer and can therefore be run on solar power. With funding from the Government of Australia, a Pacific SkyEdge hub was commissioned to manage multiple VSAT, optimize bandwidth usage, route traffic from hundreds of terminals spread around the scattered islands and atolls of the Pacific, and pool resources to support the installation of terminals in remote villages. RICS is designed to demonstrate the potential of ubiquitous access.

On 3 May 2008, the first RICS site was officially launched for operation by the government of PNG at Gaire village with a population of about 3,000–5,000 (according to the village pastor and elders). The village is about 90 minutes drive east from Port Moresby in the central province. It has electricity but no pipe water, sewerage, and fixed or mobile telephony coverage. The RICS pilot, installed at the church compound, was extended to the village school of more than 900 students and the first 100 OLPC laptops distributed there by early June 2008.

As of October 2008, 50 RICS sites had been set up across the region, and 27 were already operational in Cook Islands, FSM, Kiribati, New Caledonia, Niue, PNG, Solomon Islands, Tonga, Vanuatu, and Wallis and Futuna. Under SPC supervision, 5,000 OLPC laptops have been donated by the Massachusetts Institute of Technology (MIT) for pilot projects covering each of the Pacific islands countries and territories.

According to Oceania OLPC (www.laptop.org), in August 2008 the tiny South Pacific nation of Niue became the first country to deliver the XO laptop to *all* its children. PNG is expected to rollout the green and white laptop to all schools in 2009, after running a series of successful trials in schools and teacher training institutions in 2008. The project will benefit over 7,000 elementary and secondary schools, 1.16 million children, and 35,700 teachers.

The SPIN project aims to connect a number of Pacific states and territories with submarine optical fibre cable. Replacing satellites for major centres, the cable will provide higher bandwidth capacity, reduce costs, and improve speed to capitals and to other major population centres. It will also supplement the connectivity of the RICS sites by enabling more traffic to be handled within the Pacific.

These initiatives provide not only the mesh connectivity but also an opportunity to revisit the models on which services are based. Sharing a regional satellite that can directly provide coverage to any village highlights the potential to have locally funded and managed telephone, Internet, and broadcasting. Sharing a submarine cable service in the region improves connectivity and reduces costs. It also calls attention to the need for a mechanism for sharing the lumpy investments and returns. This will involve not only countries and operators, but also donors, vendors, and bankers.

A key disincentive for inclusion in the Information Age in the Pacific is the cost of computers. The OLPC and clones are the first steps to improving computer affordability for island countries. Combined with RICS and WiFi, OLPCs can be used to provide quality and specialized education to anywhere in the Pacific. The key will be developing mechanisms to improve applications and content.

The 'GSM in a Box' concept presented as a 'Village Connection' solution is being seriously considered as one of the more practical, cost-effective, and highly useable last mile devices. It focuses on making available cheap GSM mobile receivers with a price tag below USD 20 for people in rural and remote communities. RICS sites provide the backbone to deliver the calls to other villages and the rest of the world. The Village Connection solution was demonstrated during the May 2008 launch of RICS at Gaire village in PNG. A much bigger pilot scheduled for Niue during the Pacific Islands Forum Leaders Meeting held there in August 2008 was dropped by the Niue authorities at the last minute. However, commercial take-up of 'GSM in a Box' is being proposed for Tokelau and remote and rural areas in PNG, Vanuatu, and Solomon Islands.

EDUCATION AND CAPACITY-BUILDING

The USP IT Centre

USPNet, the distance learning network of the University of the South Pacific (USP), connects all of the extension centres in USP member countries plus the campuses in Apia, Samoa, and Port Vila, Vanuatu to the main campus in Suva, Fiji. This facility makes USP a truly regional university with a good track record of delivering distance education to the majority of its students.

In early 2007, the World Bank moved forward with its plans to upgrade USPNet as the Pacific node for its Global Distance Learning Network (GDLN). A number of opportunities that would arise from an upgraded USPNet and campus facilities include the following:

- Enhanced quality of distance learning courses.
- Enhancement of opportunities for development of research collaboration between USP and other universities around the world.
- Creation of 'Knowledge Centres' that would operate as community facilities for knowledge gathering and dissemination of information.
- Access to knowledge content from any of the more than 200 World Bank and Japan International Cooperation Agency (JICA) sites worldwide.
- Creation of a Pacific 'communications superhighway' that could be expanded to provide international communications access to remote sites within Pacific Island Countries.
- Establishing dialogues and communities of practice for island countries, including for 'red alerts' whereby network priority would be given to members dealing with emergency situations, as well as access to World Bank technical assistance in developing learning products and blended learning in particular.

Another major work in progress is a JICA-funded project to enhance USP's capacity in ICT human resource development. The Fiji-based centre will be a resource for hardware and software education and a mechanism for applications integration across sectors and intellectual policy debate about the role of ICT. With ICT issues shifting from technology and carriage to content and applications in the future, a capacity to discuss the philosophical, cultural, ethical, and consumer issues in an open and rigorous manner is essential.

PICISOC

PICISOC is the regional chapter of the Internet Society (ISOC). Founded in 1999, it is one of the most active ISOC chapters, with a growing membership. It is also generally recognized as the main resource for technical expertise, policy analysis, and unbiased assessment of regional and national ICT issues important to Pacific islanders.

Every year, PICISOC hosts the biggest ICT event in the Pacific — PACINET. Modeled on the original global INET event, PACINET brings together IT practitioners and special interest groups such as GIS users and health and education ICT workers to share their experiences and learn about new initiatives. More importantly, PACINET hosting by small island countries has brought together many expert practitioners to donate their time, expertise, and resources to some key ICT projects nominated by the host nation. For example, PACINET 2005 hosted by Kiribati provided Internet connectivity and video conference facilities

for the national Parliament complex in Tarawa. PACINET 2006 hosted by Samoa provided broadband Internet connectivity to the village school in the small island of Manono, more than 30 kilometres from Apia city. In 2007, PACINET hosted by Solomon Islands looked at extending Internet wireless coverage over a much larger area of the Marovo lagoon in the Western province. While PACINET started in 2002 in Fiji with only 20 or so participants, PACINET 2008 in Rarotonga, Cook Islands is likely to have more than 150 participants.

PICISOC has also developed good working partnerships with the Global Knowledge Partnership (GKP); many working groups of the Internet Corporation for Assigned Names and Numbers (ICANN), Asia-Pacific Network Information Centre (APNIC), and the Pacific Network Operators Group (PacNOG); Cisco academies such as those in Fiji and Samoa; UNDP and the Free and Open Source Software (FOSS) initiative; and almost all of the organizations with active participation in regional ICT developments.

ICT APPLICATIONS AND SERVICES

The application of ICT in the Pacific environment will not only follow western trends in entertainment and the economy but also exploit certain areas more effectively and faster given the Pacific's unique attributes.

e-Commerce

e-Commerce has the potential to reduce the disproportionate costs of remittances, a major source of income in most of the Pacific. This in turn would improve the capacity to spread and supplement income and generate capital for village activities. Many private operators such as Western Union offer faster services and better exchange rates than commercial banks although it can still be expensive and inconvenient for the majority in rural areas to get to the collection points, normally located in the towns and urban areas. In some countries such as Fiji, there are emerging opportunities to 'e-enable' many public utilities and essential services, including e-banking and mobile rural banking offered by the ANZ Bank and the National Provident Fund. Overall financial services in the Pacific seem set for a major shakeup and significant improvements through use of proven and appropriate ICT solutions.

Tourism is potentially a more lucrative sector for much of the Pacific. While some Web-based promotion and portals exist, the use of ICT to promote tourism, generate new revenue streams such as reliable Internet access, and improve the management of transport and other services has only been scratched.

e-Government

The potential of e-government in the Pacific has barely been touched. The historical governance models of the Pacific were overturned during the colonial period. With ICT, new models of inclusiveness are possible. Such models need to mirror the diversity of the society and be capable of fostering regional stability and security. The introduction of e-government services that merely digitize current processes will certainly increase the reach and efficiency of government but risk perpetuating power relationships.

Government and NGO websites and portals exist throughout the Pacific. At present, the main consumers for the information they provide are those in urban areas. Greater efforts are necessary to introduce and support ubiquitous carrier capacity that will allow access to these resources for the majority of Pacific islanders.

Electronic media outlets and the instant wide coverage provided by the Internet are encouraging positive changes to government policies, procedures, and operations. This is important particularly in light of concerns about the lack of transparency, corruption and the costs of doing business with government. For example, uncertainty about the details of the licence issued to Digicel in PNG has not been helpful in assuring foreign investors about investment opportunities in the country. Perhaps a lack of public explanation is to be blamed. For example, in 2007, the Minister of Finance announced that Digicel had already contributed to an increase in the country's GDP.

Other Key Applications

Education and health in the Pacific suffer from isolation and economies of scale at the village level. The capacity of the Internet to deliver specialized content and interactivity in health and education anywhere will be a major factor in improving the efficiency and effectiveness of these services and the quality of life in rural areas.

Urban drift and its economic, social, and security consequences are acutely felt in the Pacific. ICT-enabled access to services and relevant applications and content could help arrest the drift.

The preservation of the languages, cultures, and customs of the Pacific is another ICT application worth exploring. However, at present even the simplest technologies for recording, broadcasting and distributing content, such as compact disc (CD) and radio, do not yet have the necessary uptake. The financial resources and human capacity to support these ICT uses need to be strengthened to a significant degree.

These are the types of areas where Non-state Actors (NSA) can play a much larger role than they do at present.

CONCLUSION

The changes being wrought in the ICT sector are far-reaching and fundamental to society. Thus, there is a need to engage as many members of society as possible in the development of policy, the formulation of regulations, and the building of environments. Chambers of commerce and other NSA should be encouraged to participate in this process at both national and regional level. Women and church groups are a particularly significant source of support in the Pacific. Their capacity to infuse moral values and elements of social cohesion to the policymaking and capacity-building process should be utilized.

For many rural and remote communities in the Pacific and specifically for the majority without access to education and basic services, ICT brings new opportunities, knowledge, and improved life chances. ICT can effect the 'death of distance', bridge the communication and digital divide, and interconnect remote and rural communities with the global village. ICT can help better preserve local Pacific cultures while fostering better education, healthcare, entertainment, and self-esteem for Pacific islanders, regardless of their location and affiliation.

Ensuring that this potential is realized calls for an increasing share of the policy space and the economy, as well as the engagement of stakeholders. The success of reform will be determined by capacity to engineer the process. This in turn requires informed and decisive leadership on one hand, and inclusive debate on the other.

NOTES

1. The information presented in this section is drawn from Jorari (2007).
2. It was not possible to extract the same data set for Fiji, Vanuatu, and Palau based on their most recent population and housing census. The Pacific territories of American Samoa, Commonwealth of the Northern Marianas (CNMI), Guam, Pitcairn Island, French Polynesia, New Caledonia and Wallis and Futuna are also not included.
3. These include the University of the South Pacific (USP), Secretariat of the Pacific Community (SPC), Secretariat of the Pacific Islands Applied Geoscience Commission (SOPAC), Pacific Islands Forum Fisheries Agency (FFA), and Secretariat of the Pacific Regional Environment Programme (SPREP).
4. These include including the United Nations Development Programme (UNDP), Economic and Social Commission for Asia and the Pacific (ESCAP), United Nations Economic, Social and Cultural Organization (UNESCO), and ITU.

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Asia-Pacific Economic Cooperation

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INTRODUCTION

Founded in 1989 with 12 member economies, the Asia-Pacific Economic Cooperation (APEC) has since grown to become a 21-member inter-governmental body that aims to promote economic growth, cooperation, trade, and investment in the Asia Pacific region. APEC's goals are articulated in the 1994 Bogor Declaration of Goals, which envisions free and open trade for industrialized economies by 2010 and for developing economies by 2012. The Bogor Declaration also calls for the building of an environment where economies can grow; trade can flourish; skills training can be provided; and job opportunities can be created.

To achieve the Bogor Goals, APEC identified three areas of cooperation that are sometimes referred to as the 'Three Pillars' of APEC: trade and investment liberalization, business facilitation, and economic and technical cooperation. Trade and investment liberalization focuses on opening markets by reducing and eventually eliminating tariff and non-tariff barriers to trade and investment. Business facilitation focuses on reducing the cost of business transactions and improving access to trade information. Economic and technical cooperation focuses on providing training and cooperation to build capacities in all APEC member economies. Information and communication technology (ICT) is recognized as an important tool in APEC's work in all three pillars.

This chapter briefly reviews some of the key APEC policies and activities in the area of ICT development and the use of ICT for development, particularly in the context of APEC's work mechanisms and processes in pursuit of the organization's goals.

DIRECTION-SETTING AND PROGRAM IMPLEMENTATION

APEC works on the basis of non-binding commitments, open dialogue, and equal respect for the views of all of its 21 member economies.[1] All decisions are by consensus, and commitments are made on a voluntary basis. Members have no treaty obligations; they take individual and collective action to open their markets and promote economic growth in a manner that is consistent with APEC's vision.

APEC's policy direction is set by the 21 APEC Economic Leaders. The APEC Ministers and the APEC Business Advisory Council (ABAC) make strategic recommendations and are considered by the APEC Economic Leaders as part of the policy-making process. It is at the Economic Leaders' Meetings that APEC's policy agenda is shaped.

Sectoral Ministerial Meetings are held regularly on key areas such as education, energy, environment and sustainable development, finance, human resource development, regional science and technology cooperation, small and medium enterprises (SMEs), telecommunications and information industry, tourism, trade, transportation, and women's affairs.

There are four high-level committees: the Committee on Trade and Investment (CTI), the Senior Officials' Meeting (SOM) Steering Committee on Economic and Technical Cooperation (SCE), the Economic Committee (EC), and the Budget and Management Committee (BMC). They are supported by sub-committees, experts' groups, working groups, and task forces.

Working groups carry out APEC's work in specific sectors as directed by the APEC Economic Leaders, APEC Ministers, APEC Sectoral Ministers and Senior Officials. There are currently 11 working groups. Special Task Groups are formed by senior officials to identify issues and make recommendations about important areas for APEC's consideration. Ad-hoc groups have also been established to provide topical and relevant information on critical issues or to fulfil important tasks not covered by other groups.

In addition, APEC has built partnerships with various stakeholders, namely, the business sector, industry, academia, policy and research institutions, and interest groups. It has also invited the Association of the Southeast Asian Nations (ASEAN), Pacific Economic Cooperation Council (PECC), and Pacific Islands Forum (PIF) Secretariat to APEC Meetings to provide insights and expertise on specific issues.

Member economies make annual contributions to support centrally funded APEC activities. Since 1997, Japan has provided additional funds to support APEC's trade and investment liberalization and facilitation projects. Other key resources shared include professional staff assigned to the APEC Secretariat. The APEC Secretariat, based in Singapore, provides coordination, technical, and advisory support.

APEC'S ICT INITIATIVES

Taking cognizance of the profound impact of ICT, notably the Internet, on the pace and process of economic development and globalization, APEC Leaders have articulated and pursued several ICT initiatives over the years. As early as 1990, APEC formed the APEC Telecommunications and Information Working Group (APEC TEL) to focus on ICT concerns. The APEC TEL is committed to improving telecommunications and information infrastructure in the region. To implement and monitor its projects, APEC TEL created three steering groups — on liberalization, ICT development, and security.

Toward an Information Society

As it works toward the attainment of an information society that is 'people-centered, inclusive and development-oriented' (World Summit on the Information Society, Tunis 2006), APEC TEL focuses on the following priority areas: reducing the digital divide, next generation networks and technologies, e-government, mutual recognition arrangements, regulatory reform, capacity-building, protecting information and communications infrastructure and cyber security, and advancing the Asia Pacific Information Society. Specifically, APEC TEL:

1. assists developing economies in reforming their policy and regulatory structures and become World Trade Organization (WTO) compliant;
2. implements the Digital Divide Blueprint for Action and other initiatives that encourage greater access to basic communications and build-out of the Internet, so as to promote greater broadband accessibility, availability, and use;
3. develops a collaborative approach to cyber security (such as providing cybercrime legislation and enforcement, and capacity-building opportunities); and
4. works toward creating sustainable markets through both convergent and new technologies.

In June 1998, it was recognized that there was a need to update APEC-wide processes for the testing and approval of telecommunications equipment. APEC TEL facilitated what became known as the Mutual Recognition Agreement for Conformity Assessment of Telecommunications Equipment (MRA). The first such multilateral agreement, it streamlines testing and equipment certification procedures and provides for the mutual recognition, by an importing economy, of Conformity Assessment Bodies. To date, 16 out of 21 economies have committed to Phase 1 (Mutual Recognition of Test Reports) and five economies have committed to Phase 2 (Mutual Recognition of Equipment Certification). The MRA Task Force is also working on a new MRA of technical requirements. Issues being considered include potential costs and benefits to industry and regulators, and multilateral versus bilateral approaches.

Equal importance is being given to combating cyber threats. APEC TEL members have synchronized efforts under the APEC Cyber-Security Strategy, a set of measures adopted in 2002 to protect business and consumers from cybercrime and strengthen consumer trust in the use of e-commerce. A notable initiative is the development of key public infrastructure guidelines to facilitate cross-jurisdictional e-commerce. Economies are currently implementing and enacting cyber-security laws, consistent with the UN General Assembly Resolution 55/63[2] and the Convention on Cybercrime.[3] The TEL Cybercrime Legislation Initiative and Enforcement Capacity-Building Project will provide support to institutions in implementing new laws.

APEC members are also working together to implement the Computer Emergency Response Teams (CERTs) as an early warning defence system against cyber attacks. Guidelines for establishing and operating CERTs have been developed, and various training workshops provided to member economies to enhance capacity in understanding the technical, forensic, and legal issues related to cybercrime and critical infrastructure protection. The protection of SMEs is considered a priority

under this strategy. Practical tools to protect small busiesses — as well as home users — from attacks and viruses have been developed, including advice on how to use the Internet securely, safety issues relating to wireless technologies, and safe email exchanges. Work on reducing the criminal misuse of information continues to be a priority for the APEC TEL, with emphasis on the importance of sharing information, developing procedures and mutual assistance laws, and measures to protect business and citizens.

APEC member economies are encouraged to implement e-government applications. Some of the activities in this regard are the APEC e-Government Strategy, APEC e-Government Work Program, Electronic Certification Services for e-Government, e-Government High Level Symposium, e-Government University Network in HRD for e-Government, e-Government Research Project, and Integrated e-Government for Local Government Project.

The private sector is actively involved in the activities of all three TEL steering groups. Many projects are both initiated and driven solely by the private sector or in cooperation with the public sector. The APEC TEL also works with international groups, such as the International Telecommunication Union (ITU) and the Organisation for Economic Cooperation and Development (OECD).

Paperless Cross-Border Trading

Another APEC committee working on ICT initiatives is the Committee on Trade and Investment (CTI) under which are the Electronic Commerce Steering Group (ECSG) and Sub-Committee on Customs Procedures (SCCP). The CTI is the coordinating body for all of APEC's work on trade and investment liberalization and business facilitation. Established in 1999, the ECSG coordinates activities pertaining to the development and use of e-commerce within APEC. The SCCP, which was established in 1994, is tasked with simplifying and harmonizing regional customs procedures to ensure that goods and services move safely and efficiently within the APEC region.

The CTI, ECSG, and SCCP are working together toward a paperless cross-border trading environment. At the 1999 APEC Leaders Meeting in Auckland, member economies agreed on a 'voluntary basis to move toward paperless trading and eliminate the need for paper based documents in cross border trading by 2005 in developed countries and 2010 in developing economies'. It is projected that paperless trading would lower the cost of shipping goods, reduce communication charges, speed up the processing of payments, and lower paper handling costs. Paperless trading is also expected to encourage greater

participation by developing economies and SMEs in cross-border trade.

The ECSG, through the APEC Blueprint for Action on Electronic Commerce, has facilitated the preparation of Paperless Trading Individual Action Plans of 17 member economies. It has also developed a Data Privacy Pathfinder Initiative,[4] which was launched and formally adopted at the APEC Ministerial Meeting and APEC Economic Leaders Meeting in September 2007. The Pathfinder will enable stakeholders (officials, regulators, industry and consumers) to work together to better protect private information in the APEC region and build confidence and trust in e-commerce. Thirteen APEC members (Australia, Canada, Chile, Hong Kong China, Japan, Republic of Korea, Mexico, New Zealand, Peru, Chinese Taipei, Thailand, United States, and Vietnam) have agreed to participate and other members are actively considering joining the Initiative. The APEC Data Privacy Pathfinder will promote consumer trust and business confidence in cross-border data flows. It will support business needs, reduce compliance costs, provide consumers with effective remedies, allow regulators to operate efficiently, and minimize regulatory burdens.

In collaboration with the SCCP and the United Nations Centre for Trade Facilitation and Electronic Business, the ECSG undertakes work to enhance trade facilitation through technical cooperation and information sharing, specifically in electronic standards for paperless trading. Currently, the ECSG is collaborating with the International Chamber of Commerce on the development of a Framework for ICT-enabled Growth.

In 2007, the CTI formulated APEC's Second Trade Facilitation Plan, which provides the framework and schedule for implementing actions to meet APEC's objective of reducing transaction costs to business. It focuses on customs procedures, standards and conformance, e-commerce and mobility of business people. The SCCP meanwhile has formulated the Single Window Strategic Plan and Single Window Development Plan to achieve paperless trading targets and enable seamless data sharing. To further enhance paperless trading, the APEC Ministers agreed during their 19th APEC Ministerial Meeting in Sydney (2007) to work toward interoperability of systems through the use of recognized international instruments and standards.

E-Commerce capacity-building and knowledge exchange activities (i.e. symposia, technical assistance, training workshops, and seminars) have been conducted to focus on issues like intellectual property rights, data privacy, and cyber security. In 2007 the following activities were held: APEC Symposium on Paperless Trading Capacity Building and Intellectual Property Protection, Seminar on International Implementation of the APEC Privacy Framework, APEC Women's eBiz Training,

APEC Training Program on e-Trade and Supply Chain Management, and the APEC Project on Paperless Trading Capacity Building and IPR Protection.

Capacity-Building in APEC Member Economies

In 1990, APEC established the Human Resources Development Working Group (HRDWG) to coordinate and implement programs in education, labour, and capacity-building. The HRDWG is focused on narrowing the skills gap and preparing individuals for the knowledge-based economy. It has identified eight medium-term priorities in the areas of basic education; labour market; training for executives and SMEs; lifelong learning, skills and development; mobility; labour force and workplace; human resource development for trade; and investment liberalization and facilitation.

The HRDWG undertakes various programs through its three networks: the Education Network (1992), Labour and Social Protection Network (2000), and Capacity Building Network. The APEC Education Network (EDNET), formerly called the APEC Education Forum, was formed to coordinate and strengthen the collaborative activities of member economies in the field of education. It has four priority areas: Mathematics and Science Instruction, Using IT to Support Teaching and Learning, Learning Each Other's Language, and Governance and Systemic Reform. The Labour and Social Protection Network (LSPN), which first met in Brunei in May 2000, aims to foster strong and flexible labour markets and strengthen social protection, including safety nets through evidence-based interventions, collaboration, technical cooperation, and the provision of labour market social protection information and analysis to address sustainable human resource development across APEC member economies. The Capacity Building Network (CBN) promotes human capacity-building and the strengthening of markets through improved productive processes, enterprise productivity and adaptability, management and technical skill development, and corporate governance in the public, private, and voluntary sectors of APEC member economies.

Some of the major projects of the HRDWG that supports its objective of enhancing education, IT, and partnerships for development are the following:

- APEC Education Foundation, a non-profit foundation that provides grants focusing on utilizing ICT to advance education and human capacity-building cooperation in the Asia Pacific region. Among its projects are: ICT4D and disadvantaged populations in Vietnam's northern mountainous area; developing capabilities to use ICT in the improvement of educational access and quality for young people in

disadvantaged zones of Peru; the establishment of eSkwela centres for disadvantaged youth in urban areas in the Philippines; enhancing the ICT capacity of disadvantaged youth affected by social and economic factors such as low income, geographical isolation, and disability using the APEC network of certified small business counsellors in Korea; creation of digital educational resources and network access to knowledge for young people living in the Pacific Ocean zone of the Russian far east; and APEC cyber vocational education system on environmental technology in Korea.

- APEC Cyber Education Network (ACEN), a regional cooperative project that aims to narrow the digital divide among APEC member economies through the sharing of ICT knowledge and skills education.
- APEC Cyber Academy Project, an online learning environment designed for K-12 students that provides for collaborative learning across cultures and continents.
- Knowledge Bank of Policy and Practice, a Web-based repository of education policy and practical resources from the Asia Pacific region, including links to websites and documents on math and science education, language instruction, technology, and governance, for education policymakers, school administrators, and researchers.
- Seminar on best practices and innovations in the teaching and learning of science and mathematics at the secondary level where participants share pedagogic tools to increase the skills and knowledge of educators and enhance the quality of education in the APEC region.
- ICT Model School Network participated in by 16 member economies[5] to provide opportunities and means to share best practices and exchange ideas on the use of ICT in classrooms among the 71 participating schools.
- APEC Future Education Forum, a yearly meeting since 2005 that is participated in by prominent scholars, experts, education administrators from 15 member economies, to deliberate theoretical and practical strategies to formulate the vision of APEC Future Education.

Bridging the Digital Divide

In 2000, APEC Leaders set out the Brunei Goals to lay down the framework for maximizing access to the Internet and pursuing an action agenda for the new economy. Recognizing the impact of ICT and the Internet on economic development in the region. A year later, in Shanghai, China, APEC Leaders agreed 'to develop and implement a policy framework which will enable the people of urban, provincial and rural communities in every economy to have individual or community-based access to information

and services offered via the internet by 2010' (APEC 2001). As a first step toward this goal, the number of people within the region with individual and community-based access to the Internet would be tripled by 2005.

In support of the Brunei Goals, APEC Leaders meeting in Bangkok in 2003 instructed their Ministers to 'step up efforts to build knowledge-based economies' by partnering with the business sector, educational institutions, citizens groups, and government and semi-government agencies. The Brunei Goals were also affirmed with the adoption in 2001 of the long-term, forward-looking and more action-oriented eAPEC Strategy that sets a framework for bringing together an enabling environment for strengthening market structures and institutions, investment and infrastructure, and human capacity-building.[6]

In general, although APEC has yet to achieve its goal of tripling Internet access across the region, APEC economies have made significant improvements in infrastructure, as evidenced by improved teledensity and better telecommunications services. As of January 2005 six economies have more than tripled Internet access and nine economies have exceeded 50 percent Internet access. At the end of 2002, the average per capita penetration rate for fixed lines in the APEC region reached 31 percent, far above the world average of 17.9 percent. Mobile telephony increased to an unprecedented level: the mobile penetration rate exceeds 40 percent, making the APEC region the leader in mobile access. The quality of Internet access has improved with the installation of broadband infrastructure. Newer ICT infrastructure is emerging in the form of satellite connections, fibre to the home, wide area networks, and wireless networks. Public Internet access points (e.g. schools, libraries, communities/villages) have also been made available.

However, the overall development of ICT infrastructure in the APEC region has been slower than expected, and disparities between the rural and urban areas are still a major issue that needs to be addressed. Mobile telephony, which is the most pervasive, is not yet able to provide Internet access at affordable rates, and in most APEC economies, Internet access remains relatively low. The slow progress in ICT infrastructure development has been attributed to the lack of regulatory policies in many APEC member economies, as well as lack of financial and technical capabilities in developing countries. The affordability of ICT infrastructure remains an issue in some APEC economies.

On the other hand, developments in ICT infrastructure have been attributed to liberalization and sound regulation policies. An extensive survey conducted by the APEC TEL (2003) found that majority of the member economies have implemented the WTO regulatory principles of competitive safeguards, interconnection, public availability of licencing criteria, independent regulators, and allocation and use of scarce resources.

Complementing infrastructure development as a strategy for addressing the digital divide is developing digital and related skills for the knowledge economy and society. In 2001, the APEC High Level Meeting on Human Capacity Building adopted the Beijing Initiative, which called for a collaborative effort among member economies and stakeholders to share experiences and practices, explore better approaches, and identify strategic options in human capacity-building.

CHALLENGES AND OPPORTUNITIES

Effective governance requires the active involvement of all sectors. This is also true for APEC where the member economies' commitment is as important as stakeholders' participation in APEC activities. APEC's working method also reflects its desire to be inclusive in its engagements inasmuch as APEC member economies have diverse socio, political, and economic conditions. It promotes collaborative initiatives and the sharing of practices among its members, stakeholders, and partners.

However, while staying true to its commitment to consensus-building and stakeholder participation, APEC needs to come up with clear-cut, effective, and enforceable agreements and decisions, and a strategy for implementing these in a timely fashion.

APEC is faced with many challenges and its usefulness in the region and its comparative advantage relative to other regional organizations are constantly tested. Internally, APEC needs to address structural issues concerning the APEC Secretariat and encourage member economies to increase their financial contributions. Since its creation almost two decades ago, APEC's scope of work has continuously expanded while its support mechanisms have remained the same. The 3rd APIAN Policy Report (2002, p. 15) states that 'APEC's financial structure is woefully inadequate in comparison to APEC's goals and objectives' and its 'management structures have grown both too complex and too weak to meet the growing demands of a growing organization and need a thorough overhaul'. However, as the 2007–2008 State of the Region Report (SOR) of the PECC notes, efforts to strengthen the Secretariat are routinely met with resistance.

The PECC report also observes that there is overlapping of activities, and there is no coordinating mechanism to eliminate the wasteful duplication of resources. This is especially true in human capacity-building as almost all of the APEC working groups undertake capacity-building activities. Furthermore, while 'some capacity-building has taken place … there is no systematic institutional commitment to technical assistance across the range of issues on of Leaders' agendas' (PECC 2008).

'Strategically, APEC stabilizes relations among its diverse membership by providing a unique forum for regular discussions among leaders, ministers, technical experts and corporate executives' (APIAN 2002, p. 13). What is needed is for APEC to extend its philosophy of openness to include making the necessary internal changes that will make it an effective regional organization able to maintain its relevance in the region.

NOTES

1. The 21 member economies are Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russia, Singapore, Chinese Taipei, Thailand, United States, and Vietnam.

2. 'Combating the criminal misuse of information', which recognizes that one of the implications of technological advances is increased criminal activity in the virtual world (United Nations 2001).

3. An agreement forged in Budapest that aims to uphold the integrity of computer systems by considering as criminal acts any action that violates this integrity (Council of Europe 2001).

4. The Pathfinder Initiative is an approach adopted by APEC to enable groups of member economies to pilot the implementation of cooperative initiatives prior to their adoption by all APEC member economies. This approach allows APEC member economies who are ready and willing to commit to move faster in specific areas to do so and it is seen as a way to invigorate progress toward the free trade and investment goals.

5. Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Indonesia, Hong Kong China, Japan, Korea, Malaysia, Mexico, Philippines, Singapore, Chinese Taipei, Thailand, and Vietnam.

6. A detailed description is provided in the report of the Pacific Economic Cooperation Council to APEC Ministers entitled 'Implementing the eAPEC Strategy: Progress and recommendations for further action' (APEC Secretariat 2004).

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Association of Southeast Asian Nations

Lim Hock Chuan

INTRODUCTION

The Association of Southeast Asian Nations (ASEAN) was established 40 years ago on 8 August 1967 with five founding members.[1] Today ASEAN has 10 Member States: Brunei Darussalam, the Kingdom of Cambodia, the Republic of Indonesia, the Lao People's Democratic Republic, Malaysia, the Union of Myanmar, the Republic of the Philippines, the Republic of Singapore, the Kingdom of Thailand, and the Socialist Republic of Vietnam. It covers 'a population of about 550 million, a total area of 4.5 million square kilometres, a combined gross domestic product of about USD 1 trillion and total trade of more than USD 1.4 trillion' (ASEAN Doc. #19226 n.d.).

On the occasion of its 30th anniversary in 1997, the Association embarked on the serious task of building the ASEAN Community by 2020. This signals the gradual expansion of regionalism in ASEAN beyond the traditional boundaries of market integration to include the political, social, and cultural spheres.

This chapter takes a closer look at the regional aspirations expressed in the vision of an ASEAN Community and the role that information and communication technologies (ICTs) can play in its realization. It proposes a conceptual framework, consisting of interrelated concepts of a regional learning and innovation culture, sustainable knowledge systems, and communities of practice, for building the ASEAN Community. Regional development is a complex undertaking for which many concepts will have relevance. This chapter limits itself to outlining only a few of these concepts.

ENVISIONING AN ASEAN COMMUNITY

In 1997, ASEAN Leaders articulated a vision of ASEAN as 'a concert of Southeast Asian nations, outward looking, living in peace, stability and prosperity, bonded together in partnership in dynamic development and in a community of caring societies' (ASEAN Doc. #5228 n.d.). This is consistent with ASEAN's desire to be a region that represents the 'collective will of the nations of South-East Asia to bind themselves together in friendship and cooperation and, through joint efforts and sacrifices, secure for their peoples and for posterity the blessings of peace, freedom and prosperity' (ASEAN Doc. #1212 n.d.).

ASEAN is further guided by a set of fundamental principles agreed upon by its members under the Treaty of Amity and Cooperation in Southeast Asia signed in 1976 and affirmed under the Bali Concord II signed in 2003. These principles, which together comprise the code of conduct governing relations between states, are stated in the ASEAN Charter as follows (ASEAN Doc. #1217 n.d.; ASEAN Doc. #21069 n.d.):

- respect for the independence, sovereignty, equality, territorial integrity, and national identity of all ASEAN Member States;
- shared commitment and collective responsibility in enhancing regional peace, security, and prosperity;
- renunciation of aggression and of the threat or use of force or other actions in any manner inconsistent with international law;

- reliance on peaceful settlement of disputes;
- non-interference in the internal affairs of ASEAN Member States;
- respect for the right of every Member State to lead its national existence free from external interference, subversion, and coercion; and
- enhanced consultations on matters seriously affecting the common interest of ASEAN.

In 2003, ASEAN Leaders also resolved that 'an ASEAN Community shall be established comprising three pillars, namely, [the] ASEAN Security Community, ASEAN Economic Community and ASEAN Socio-Cultural Community' (ASEAN Doc. #147 n.d.). The ASEAN Security Community (ASC) is 'envisaged to bring ASEAN's political and security cooperation to a higher plane where countries in the region live in harmony with one another and with the world-at-large' (ASEAN Doc. #17359 n.d.). The ASEAN Economic Community (AEC) is envisaged to be 'a single market and production base, character-ized by the free flow of goods, services, investment and skilled labour, and freer flow of capital by year 2020' (ASEAN Doc. #15065 n.d.). The ASEAN Socio-Cultural Community (ASCC) is envisaged as a 'community in consonance with the goal set by ASEAN Vision 2020, in which we would be bonded together in partnership as a community of caring societies. Through the ASEAN Socio-Cultural Community, we could foster our cooper-ation in social and rural population, and at the same time, seek the active involvement of all sectors of society, including women, youth and community groups' (ASEAN Doc. #15259 n.d.). These communities are to be 'closely intertwined and mutually reinforcing for the purpose of ensuring durable peace, stability and shared prosperity in the region' (ASEAN Doc. #15159 n.d.).

MOVING TOWARD THE ASEAN VISION

In 2007, ASEAN proudly celebrated 40 years of regional collaboration and cooperation with the signing of the ASEAN Charter at the 13th ASEAN Summit.[2] The Charter introduces significant institutional changes within ASEAN, and gives ASEAN 'for the first time after 40 years of existence … the legal personality of an Inter-Governmental Organization' (ASEAN Doc. #21088 n.d.). The Charter also stipulates the following:

- ASEAN Foreign Ministers will form the ASEAN Coordinat-ing Council (ACC) to assist ASEAN Leaders in preparing for Summits, with the support of the Secretary-General (SG) of ASEAN and the ASEAN Secretariat (ASEC).

- There will be a Committee of Permanent Representatives (PRs) to ASEAN that shall take over the functions of the ASEAN Standing Committee. The PRs shall be appointed by each Member State.
- There will be a new ASEAN human rights body.
- The ASEAN Foundation will be accountable to the SG of ASEAN.
- Decision-making will continue to be based principally on consultation and consensus. Where consensus cannot be achieved, the ASEAN Summit may decide how a specific decision can be made.
- Flexible participation, such as the ASEAN Minus X formula, may be applied where there is a consensus to do so.
- The mandate and role of the SG of ASEAN shall be enhanced especially in interpreting the ASEAN Charter if and when requested, and in advancing the interest of ASEAN and its legal personality.
- Four Deputy Secretary-Generals (DSGs) shall be appointed. The three ASEAN Community Councils will be headed by one DSG each and the fourth DSG may concentrate on ASEC affairs and on narrowing the development gap among ASEAN Member States.
- There shall be no change to the equal sharing of contributions to the annual operating budget of the ASEAN Secretariat.

Another landmark ASEAN event in 2007 was the issuance of the Declaration on the ASEAN Economic Community (AEC) Blueprint. This stipulates the creation of a single ASEAN market and production base and the establishment of the ASEAN Economic Community by 2015 (ASEAN Doc. #21082 n.d.). In essence, the single market and production base of the AEC comprises five core elements: free flow of goods, free flow of services, free flow of investment, freer flow of capital, and free flow of labour. The single market and production base shall also include the priority integration sectors and food, agriculture, and forestry.[3]

The ASEAN Charter and the AEC Blueprint are intended to improve institutional mechanisms to allow ASEAN to be better prepared for the 21st century. ICTs have an important role to play in their implementation. The key ICT-related areas and opportunities within the AEC Blueprint/Priority integration sectors are shown in Table 11.1.

The strategic directions outlined in Table 11.1 build on previous accomplishments in ICT-related aspects of the work of ASEAN. For example, the 6th ASEAN Telecommunications and IT Ministers (TELMIN) meeting was held in September 2006 with the theme of 'Enhancing ICT Competitiveness: Capacity-Building'. The focus of the meeting was to address common issues relating to 'creating a conducive, competitive

Table 11.1
ICT-related areas and opportunities within the AEC blueprint/priority integration sectors

Strategic approach	Priority actions			
	2008–2009	2010–2011	2012–2013	2014–2015
B. Toward a highly competitive region				
B4. Infrastructure development				
• Information infrastructure – Brunei action plan of ICT – ICT focus	• Implement the ASEAN Telecommunications Regulators Council (ATRC) Mutual Recognition Arrangement (MRA) on conformity assessment for telecommunication equipment • Promote and deepen policy and regulatory measures to deal with the opportunities and challenges in the area of Next Generation Networks (including the issue on broadband penetration and communications in rural areas, etc.)	• ASEAN-wide implementation of the ASEAN MRA on conformity assessment for telecommunication equipment • Implement regional measures to extend connectivity, capacity, and access in and between member countries via high-speed networks between national information infrastructures • Enable the interoperability of products/services, information systems and networks, in a convergence environment		
	• Develop a general framework or guidelines for coordinated ASEAN e-government programs for efficient delivery of public services, and to facilitate regional trade, investment and other business activities • Activate the ASEAN e-Government Forum, among others, to identify key public services for ICT applications, including capacity building activities • Intensify capacity building and training for national computer emergency response teams (CERTs) and strengthen cooperation and coverage of an ASEAN regional cyber-security network			
• Content industry	• Develop an action plan for MRA and/or Certification of ICT professionals in ASEAN • Develop an action plan for developing ASEAN content, Web services and online application industries			
B6. e-Commerce	• Member countries to enact their e-Commerce laws	• Update and/or amend relevant legislation in line with regional best practices and regulations in e-Commerce activities		• A harmonized legal infrastructure for e-Commerce fully in place in ASEAN
	• Adopt regional framework and strategy for the mutual recognition of digital signatures • Continued capacity building and information sharing for Member Countries on e-Commerce legal infrastructure activities (e.g. PKI, institutional strengthening for CAs, etc.)	• Advancing cross-border electronic transactions, through pilot implementation of mutual recognition of foreign digital signatures		

Note: For details of the strategic schedule for the AEC, see ASEAN Doc. #21161.

and sustainable ICT environment; developing digital content; ensuring network security as well as important initiatives for strengthening human and institutional capacities in the ASEAN ICT sector.' The Brunei action plan, a focused formal agreement, was a significant outcome of this meeting (ASEAN Doc. #18849 n.d.; Sonny 2006).

The 7th ASEAN TELMIN meeting was held in August 2007 with the theme 'ICT: Reaching out to the rural'. Ministers at this meeting adopted the Siem Reap Declaration on Enhancing Universal Access to ICT Services, which provides 'policy direction toward developing affordable access to ICT services in rural communities and remote areas in each ASEAN member country' (ASEAN Doc. #20878 n.d.; *Brunei Times* 2007). An important step taken at this meeting was the agreement to promote partnerships and shared responsibilities between the private and public sectors, and international organizations and agencies. ASEAN is moving toward the deployment of ICT for social and cultural development, as well as improving institutional mechanisms for the coordination, management, and implementation of ASEAN ICT cooperation work projects and programs.

The 8th ASEAN TELMIN meeting was held in August 2008 with the theme 'High Speed Connection to Bridge ASEAN Digital Divide'. Ministers adopted concrete measures for enabling ICTs for ASEAN Economic communities, promoting high speed connections to bridge the digital divide, and improving ASEAN ICT integration activities. A key focus of the meeting was 'incorporating high speed connection for most affordable telecommunication/ICT access and services' (ASEAN Doc. #21916 n.d.).

Improvements in institutional mechanisms and the design of supporting programs, especially in the designated areas of science and technology, trade, social and cultural domains, and ICT-related fields will influence and shape the engineering of the ASEAN Community. ASEAN Leaders have agreed to begin with the building of the AEC and related supporting programs. These are important starting steps in the formative phase. However, as 2010 draws near, ASEAN also needs to give due consideration to the equally important pillars of social and cultural development in the ASEAN Community and harness informal networks and communities. This is discussed further in this chapter.

BUILDING THE ASEAN COMMUNITY

The idea of an ASEAN Community is not just a change in direction and form. More importantly, it is a change of mindsets — that is, a paradigm shift from 'a loose grouping of member states' to an integrated and cohesive community. This shift will take place through planned, incremental changes in varying stages, rather than through a sudden, revolutionary change. It is also a shift or transformation that would require not only institutional mechanisms and policies but also the broad participation of various stakeholders in knowledge creation and innovation. ICTs can be used to enable this broad participation.

Leveraging ICTs

The potential of ICT to foster development is well documented by leading agencies. For instance, the Global Information Technology Report of 2006–2007 indicates that 'there is growing evidence that ICT is driving innovation' (Dutta and Mia 2007). A recent OECD report states:

> … new ICT applications have significant potential and may well have strong economic and social impacts in the near future; ICTs also play a fundamental role in the interlinking and convergence of different technologies. Among these emerging technologies are ubiquitous networks, which make it possible to follow persons and objects and provide real-time tracking, storing and processing of information. Applications of enabling network technologies such as radio frequency identification (RFID) and other sensor technologies are increasingly affordable, investment is rising and applications are moving into commercial use. (OECD 2006, pp. 19–20)

Many would agree that ICT is a key enabler and driver of productivity and growth. But just as important is the potential of ICTs to help build communities. ICTs enable new ways of accomplishing work, delivering services, and enabling social participation. Indeed, the perspective on ICT in the region has shifted from 'what we have' to 'what we are doing with it' to 'what it means to us' — essentially the 'softer' socio-cultural aspects of technology. This shift from a technology-centric to a socio-culture-centric view reinforces the significant role of technologies in fostering learning and innovation for social change.

Fostering an ASEAN Regional Learning and Innovation Culture (RLIC)

Learning and innovation have recently become the focus of development research. 'Innovation and learning are closely linked' (Cooke et al. 1997, p. 484). They are essential for resourceful thinking and creative problem solving at the individual level and for collective enhancement of social capital at the group level. With regard to the ASEAN Community, it

is useful to focus on learning, innovation, and social capital at the group level.

Adler and Kwon (2002, p. 17) describe social capital 'as the goodwill that is engendered by the fabric of social relations and that can be mobilized to facilitate action'. Fukuyama (1999) defines social capital as 'an instantiated informal norm that promotes cooperation between two or more individuals'. These definitions are relevant to ASEAN community building: they imply that '… involvement and participation in groups can have positive consequences for the individual and the community' (Portes 1998).

Equally important for building the ASEAN Community is an understanding of the sources of social capital. Portes (1998) and Adler and Kwon (2002) identify the following sources of social capital: the structure of relationships, authorities, informal norms, and culture. For ASEAN, it is the strength of the social capital embedded in social networks that will further integration and social cohesion of the ASEAN Community. Informal norms and culture are especially important. As Fukuyama (1999) notes, 'The fact of the matter is that coordination based on informal norms remains an important part of modern economies, and arguably becomes more important as the nature of economic activity becomes more complex and technologically sophisticated.' In the ASEAN region, close family ties and formal and informal connections contribute to the enhancement of social capital.

Another important source of social capital in ASEAN is education. Indeed, the value for education is common to ASEAN cultures. Anecdotal evidence suggests that many families give priority to education and training over other needs, such as taking a major family vacation or purchasing luxury goods. The importance of education and training is recognized at the regional level and ASEAN Leaders in 2005 institutionalized the ASEAN Education Ministers Meeting (ASED) as a regular ASEAN meeting to address key education issues.

The premium placed on social networks and education in ASEAN communities bodes well for the formation of a regional culture of learning and innovation that in turn could be the foundation of the ASEAN Community.

Nurturing Sustainable Knowledge Systems (SKS)

An ASEAN RLIC would lead to the creation and regional embedding of knowledge and knowledge systems. SKS in particular should form part of the foundation of the ASEAN Community.

In regional studies, it is not uncommon to find regional innovation systems (RIS), clusters, and learning regions mapped to real-world regions. However, the analyses tend to have a more technical bias, particularly when the knowledge that is produced or learned is deemed to be coming from firms or industrialized

regions geared toward greater competitiveness. For ASEAN, the useful knowledge gained within the ASEAN Community is not just technical or commercial knowledge. An ASEAN RLIC would and should generate social and cultural knowledge as well. The collective and generic term 'knowledge systems' takes into account the diversity of knowledge generated. The term 'system' is slightly modified from Lundvall (1992) and in the ASEAN context it is taken to mean a collection of distinct entities with defined relationships and interactions. Knowledge systems in the ASEAN context therefore refer to the knowledge content derived from defined relationships and social interactions. These knowledge systems become sustainable when resources are properly managed; stakeholders from public, private and civil society organizations, and communities have well-defined roles and relationships; and relevant stakeholders take appropriate ownership.

The RLIC and the SKS complement each other and underpin the building of the ASEAN Community. The RLIC creates and produces useful knowledge while the SKS maintains and ensures sustainability. These also correspond to two orders of change in systems theory (Watzlawick et al. 1974). First order change involves a change of system artefacts, while second order change is aimed at the systemic level. Applied to the ASEAN context, ICT for development in first order change improves the quality of created knowledge, and in second order change improves the knowledge creation process. ICT-enabled informal communities of practice play important roles as suppliers of knowledge and domain information and, together with other key ASEAN stakeholders they can implement the necessary first and second order change. The challenge for ASEAN is how to nurture the right communities and SKS and engage in the appropriate level of change.

Building Communities of Practice (CoPs)

To further operationalize the concepts of ICT-enabled RLIC and SKS in the ASEAN Community, let us turn to the relatively new field of Community Informatics. Community Informatics is interested in how to effectively use ICT in evolving communities — that is, communities of practice (CoPs) and interest, as well as geographically-based communities (de Moor and De Cindio 2007).

CoPs are not a new phenomenon (Wenger and Snyder 2000). CoPs are groups 'of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis' (Wenger et al. 2002, p. 4). CoPs create and manage knowledge and drive innovation (Lesser and Storck 2001; Swan et al. 2002).

How can ASEAN build CoPs that will develop a regional culture of learning and innovation and build sustainable knowledge systems?

Now that it has completed a number of key ICT infrastructural projects, developed digital content, trained professionals, compiled databases, and adopted best practices, ASEAN is ready to build CoPs. ASEAN websites and Web portals in particular could support the building of CoPs.

ASEAN Websites for CoPs

In ASEAN, as elsewhere, the Internet is an important and effective tool for managing information, stimulating participation, and embedding and sharing knowledge. Websites and Web portals are frequently used as a common interface and tool in the management process of many ASEAN meetings. Moreover, many ASEAN sectors have a website. These include: ASEAN Secretariat (www.aseansec.org), ASEANconnect (www.aseanconnect.gov.my), ASEAN Science and Technology Network (www.astnet.org), ASEAN Supporting Industry Database (www.asidnet.org), ASEAN Centre for Energy (www.aseanenergy.org), ASEAN Culture and Information (www.aseaninfoculture.org), ASEAN Tourism (www.asean-tourism.com), ASEAN Tourism Association (www.aseanta.org), ASEAN Inter-Parliamentary Organization (www.aipo.org), ASEAN University Network (www.aun-sec.org), ASEAN Production Houses and Broadcasters (www.aseanmediadirectory.com), ASEAN Foundation (www.aseanfoundation.org), Southeast Asian Fisheries Development Centre (www.seafdec.net), Southeast Asian Ministers of Education Organization (SEAMEO, www.seameo.org), and SME Networks (www.aseansec.org/12877.htm).

In order for such websites to serve as spaces for building CoPs, they need to meet the criteria of 'participatory coverage' and 'content generation'. Participatory coverage takes into account membership and thematic focus, while content generation refers to a website's potential for learning, innovation, knowledge sources, and sharing. Using these criteria to assess the ASEANconnect and the ASEAN Science and Technology (AST) Network websites yields the following observations (see Table 11.2).

Both websites are intended for related groups of people in the ASEAN Member States. ASEANconnect (www.aseanconnect.gov.my) is an ICT portal for members of TELMIN, TELSOM, ARTC, and invited groups while the newly revamped ASEAN Science and Technology Network (www.astnet.org) is intended for the S&T community. Both websites feature databases in selected fields. They form an important foundational layer of networks and servers that could be upgraded to allow for Internet content integration, user interaction, and user management. Indeed, as announced at the Thirteenth ASEAN Summit in 2007, 'USD 240,500 was given to the ASEAN Secretariat to upgrade its Information Technology, archival and depository systems' (ASEAN Doc. #21093 n.d.). While this amount may not be sufficient to also build CoPs, it is an opportunity for ASEAN to take advantage of the work window and incorporate the required technology infrastructure that would allow integration and develop CoPs where needed. Combined with a consultative and participatory approach at an appropriate level and with suitable stakeholders, it would enable ASEAN to reap the benefits of additional knowledge creation.

However, some conditions that are useful for building CoPs could also limit them. When knowledge is seen as a 'public good

Table 11.2
Potentials of two ASEAN websites to foster CoPs

Criteria	ASEAN connect (2005)	AST network (2005)
Participatory coverage: Membership	Participation or membership is by invitation. The coverage is the whole of ASEAN and invited groups. There is restricted access to the members' only areas (TELMIN, TELSOM, ARTC, ASEC, and invited groups). New or other interested stakeholders cannot sign up to join from the Internet.	Membership and participation is restrictive even with the Community Forum feature. Non-members cannot post to the forum. The coverage is the S&T of ASEAN plus invited groups.
Participatory coverage: Thematic focus	Single theme, ICT.	Single theme, S&T.
Content generation: Learning	The information presented is situated within the ICT theme and focus. Learning potential exists.	The community forum is a good venue for limited interaction and sharing. Higher learning can be expected.
Content generation: Innovation	Fostering of innovation is limited to email exchanges.	Fostering of innovation is limited to email and forum exchanges.
Content generation: Knowledge sources	Digital divide database, news and discussion papers.	S&T Indicators' database, forum, reports, news.
Content generation: Knowledge sharing	Average, not fully interactive.	Average, not fully interactive.

belonging to the whole organization, knowledge flows easily'. But individuals tend to shy away from contributing knowledge for a variety of reasons (Ardichvili et al. 2003). The challenge is how to encourage knowledge sharing particularly in formal and hierarchical contexts. Malpractice can also curb knowledge sharing (Pemberton et al. 2007). In short, CoPs need to be carefully managed. Once the appropriate CoPs are in place, ASEAN can look forward to greater participation in the creation and exchange of useful knowledge.

CONCLUSION

This chapter has focused on ASEAN's vision of an integrated and cohesive ASEAN Community and how ICT can be used to turn this vision into reality. Given ASEAN's 40-year history in building regional institutions and adopting regional policies, the vision of an ASEAN Community must necessarily go beyond what ASEAN has achieved in the political and economic spheres to the social and cultural levels. In this age of rapid change, ASEAN needs to build a stronger regional learning and innovation culture and sustainable knowledge systems that will serve the needs of the people of ASEAN and enable them to participate in the building of an ASEAN Community as members of local and global communities of practice.

NOTES

1. ASEAN was established on 8 August 1967 in Bangkok by the five original Member Countries, namely, Indonesia, Malaysia, Philippines, Singapore, and Thailand. Brunei Darussalam joined ASEAN on 8 January 1984, Vietnam on 28 July 1995, Lao PDR and Myanmar on 23 July 1997, and Cambodia on 30 April 1999 (ASEAN Doc. #147 n.d.).
2. The 13th ASEAN Summit was held on 18–22 November 2007 in Singapore. The ASEAN Charter was signed on 20 November 2007.
3. For full details, readers can refer to the entire Blueprint ASEAN Doc. (n.d.q), ASEAN economic community blueprint.

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South Asian Association for Regional Cooperation

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INTRODUCTION

The South Asian Association for Regional Cooperation (SAARC) was formed by the governments of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka in 1985 to catalyze regional cooperation in economic and social development in the member countries. In 2007, Afghanistan joined SAARC.

The core areas of cooperation among the SAARC countries are agriculture and rural development; health and population activities; women, youth, and children; environment and forestry; science, technology, and meteorology; human resource development (HRD); and transport. SAARC activities in these areas are implemented through the Integrated Programme of Action (IPA) and coordinated by the SAARC Secretariat based in Kathmandu, Nepal. Besides the IPAs, high-level working groups consisting of ministers are formed to facilitate cooperation, including in information and communication technologies (ICTs).

However, although there has been considerable growth in connectivity, content, and capacity of the ICT sectors of South Asian countries in the last decade, SAARC's role in this advance is difficult to trace. It was only at the 9th SAARC Summit held in Malé, Maldives, in 1997 that SAARC member governments noted the lack of communication facilities as a major hindrance to economic cooperation. The Malé Summit stressed the importance of developing infrastructure and adequate communications networks in member countries to facilitate economic cooperation. The need to simplify complex documentation procedures and use transactional software to facilitate economic interaction was likewise discussed.

The First Conference of the SAARC Communications Ministers, held in Colombo in May 1998, dealt with regional cooperation for telecommunication sector development in the region. A Plan of Action on Telecommunications (PAT) was adopted during this conference. It took another six years for the Second Conference of the SAARC Communications Ministers to take place. This Second Conference, held in Islamabad in June 2004, adopted the revised PAT 2004 with the following aims:

- To promote cooperation in the enhancement of telecommunication links and utilization of information technologies within the SAARC region;
- To minimize disparities within and among member countries in the telecommunications field;
- To harness telecommunication technology for the social and economic upliftment of the region through infrastructure development by optimal sharing of available resources and enhanced cooperation in technology transfer, standardization, and HRD; and
- To evolve a coordinated approach on issues of common concern in international telecommunications fora.

The Second Conference stressed the need to address the digital divide, knowledge sharing on ICT development among member countries, and HRD in the ICT sector. A year later, SAARC made its presence felt in the global ICT scene when it presented a common position paper on issues in the region's telecommunications sector at the November 2005 World Summit on the Information Society (WSIS) in Tunis.

The sections that follow present SAARC's key initiatives in ICT and ICT for development (ICTD) in recent years. In general,

SAARC's role in fostering regional collaboration in ICTD has been lacklustre. The concluding section outlines some steps that SAARC can take to improve the situation.

KEY ICTD INSTITUTIONS IN SAARC

As an inter-governmental agency, SAARC works mostly through inter-governmental ministries and line agencies such as the Ministries of Information and Communications. It also forms specialized working groups in the form of technical committees, and works through several regional centres that deal with specific issues in South Asia. Currently, there are nine such regional centres located in various member countries:

1. SAARC Agricultural Information Centre (SAIC) in Dhaka, Bangladesh
2. SAARC Meterological Research Centre (SMRC) in Dhaka, Bangladesh
3. SAARC Tuberculosis Centre (STC) in Kathmandu, Nepal
4. SAARC Documentation Centre (SDC) in New Delhi, India
5. SAARC Human Resource Development Centre (SHRDC) in Islamabad, Pakistan
6. SAARC Coastal Zone Management Centre (SCZMC) in Malé, Maldives
7. SAARC Information Centre (SIC) in Kathmandu, Nepal
8. SAARC Energy Centre (SEC) in Pakistan
9. SAARC Disaster Management Centre (SDMC) in New Delhi, India.

Some regional centres generate and share information and they have organized meetings on some of the ICT sectors, such as radio and television. The SDC has also conducted short-term and attachment training programs on information technology applications for library, documentation, and information professionals in the member states.

While there is no SAARC centre that specifically deals with the development of the ICT and ICTD sector in the region, some ICT and ICTD-related issues in HRD, online services, knowledge sharing, and others can be integrated within the current structure of the SAARC regional centres in a more organized way. For example, the SHRDC could have a regular program on ICT HRD. Similarly, the SIC in Kathmandu could carry out ICT-related research and development (R&D) activities. It can also collect data and build a database on ICTs and ICTD in South Asia.

The SDMC was set up in October 2006 to provide policy advice on and capacity-building for strategic learning, research, training, system development, and exchange of information for effective disaster risk reduction and management in South Asia. One of its more notable ICT-related research initiatives is the preparation of a digitized vulnerability atlas of South Asia integrating spatial data on physical, demographic, and socio-economic features of different regions in the member countries. The vulnerability atlas shall be prepared on a GIS platform using the latest remote sensing data showing geo-physical and climatic hazard zone classification on a specific scale and integrating available census data on demography, socio-economic conditions, housing types, and the like. In addition, the SDMC's networking strategy specifically mentions 'use [of] information and communication technologies to develop a virtual resource centre for disaster management in South Asia'. However, no information is currently available on the status of these ICT-supported activities for disaster management in the region.

ENABLING POLICIES AND PROGRAMS

Several policies and plans for the development of the ICT sector and ICTD in the member countries have been adopted at the SAARC Summits. The extent to which these have been implemented remains unclear. Nevertheless, some of their more significant provisions are worth mentioning.

Plan of Action on Telecommunication 2004

The revised PAT 2004 adopted by the SAARC communications ministers recommends the reduction of telecom tariffs within the SAARC region to the lowest extent feasible within the framework of cost orientation based on international benchmarks. It also recommends the use of direct links or of a hubbing/transit facility for intra-regional traffic. Special rates are to be offered by the member states for transiting regional traffic and utilization of the facilities by the other member states for overflow traffic. For this purpose, licenced international long distance operators are to be encouraged to frequently negotiate agreements for offering the lowest possible tariffs.

To facilitate intra-regional communications for travellers and entrepreneurs, the revised plan recommends the promotion of country direct services, calling cards, cellular roaming, and liberalized leased lines within the regulatory frameworks of the member states. For this purpose the member states are to encourage: (i) complete digitalization of inter-country links as soon as possible; (ii) settlement of inter-operator revenues within the timeframe set under international telecommunication regulations; (iii) calling card services by facilitating centralized or

decentralized credit verification systems; *(iv)* a cellular roaming facility within the region; and *(v)* determining the feasibility of establishing an intra-regional high bandwidth hub for leased lines.

Since 2004, most of the SAARC member countries have reduced telecom tariffs and they have set up hubbing facilities that allow among others mobile roaming in several South Asian countries. Beginning 1 June 2008, the Pakistan Telecommunication Authority (PTA) reduced Mobile Termination Rates (MTR) by about 30 percent. In September 2008, Nepal Telecom revised tariffs on Global System for Mobile communication (GSM) mobile, Code Division Multiple Access (CDMA) and Public Switched Telephone Network (PSTN) phones, and the Internet.

The revised plan also recommends the following:

- Promotion of R&D activities and exchange of expertise in telecommunications disciplines;
- Enhancement of HRD in the telecoms sector through greater cooperation and better utilization of the existing training facilities in the region (including the provision of fellowships by the member states);
- While liberalizing telecommunication services, ensuring: *(i)* universal access; *(ii)* development of rural services with affordable tariffs; and *(iii)* viable incentives to service providers to achieve these goals;
- Consultations at multiple levels among communications ministries and regulatory authorities to evolve common positions on telecommunication issues of regional concern at international fora;
- Cooperation among regulatory authorities and administrations to develop policies to increase teledensity and access to ICT at affordable rates; and
- Exchange of information and expertise in the development and utilization of ICT in e-commerce, healthcare, education, and other areas.

SAARC Common Position on the Information Society

The SAARC position paper on the Information Society presented at the WSIS in Tunis in 2005 basically supported the implementation and follow-up of the Geneva Declaration of Principles and Plan of Action by stakeholders at national, regional, and international levels, with particular attention to challenges facing the least developed countries. It also expressed support for the Tehran Declaration on Building the Information Society and Regional Action Plan toward the Information Society in Asia and the Pacific adopted at the High-Level Asia

Pacific Conference for the World Summit on the Information Society in Tehran. Stakeholders, including governments, the private sector, civil society, and regional and international organizations, were called upon to strengthen their partnerships to implement the Regional Action Plan toward the Information Society at all levels.

The SAARC common position also expressed support in principle for a funding mechanism to support the development of ICT in low-income countries, and the conduct of internet governance in a more democratic way. It affirmed the role of governments in internet governance and sought to review the report of the Working Group on Internet Governance (WGIG) in this context.

The development of action plans giving special attention to issues common in the region, and of ICT networks in rural areas to reinforce the process of economic cooperation was also affirmed by the SAARC common position. Recognizing ICT as an effective tool to promote e-governance and improve services to citizens, the position paper called for harnessing ICT for social and economic development, preservation of linguistic and cultural diversity, increasing literacy rates, and access to information for all. Specific mechanisms that were mentioned were building and expanding community-based multi-purpose ICT centres and providing support for public service broadcasting.

The role of media in building the Information Society was affirmed, and specific recommendations were given to:

- develop regional networks and associations among media organizations;
- encourage media projection of development activities and other achievements in different fields;
- continue to pursue freedom of expression and plurality of media, including promotion of private electronic channels, with the objective of discouraging negative projections of member countries;
- continue to promote, through media, peace and fundamental values of freedom, equality, solidarity, and tolerance and shared responsibilities;
- invest in technological and institutional solutions to promote universal access to media; and
- accelerate steps to strengthen cooperation in institution building and training of media personnel.

There was also a commitment to improve the free flow of information in the member countries by building adequate communication networks and creating appropriate legal and institutional systems, including devising an appropriate and legally enforceable instrument to combat cybercrime.

SASEC ICT Development Master Plan

Distinct from SAARC but still within the ambit of regional co-operation is the South Asia Subregional Economic Cooperation (SASEC) that includes Bangladesh, Bhutan, India (i.e. the eastern states of India), and Nepal. SASEC provides a forum for participating countries to discuss, identify, prioritize, and implement sub-regional cooperation projects in six priority sectors, including ICT. The ICT Working Group (ICTWG) composed of secretaries and/or joint secretaries from finance ministries of the SASEC countries, secretaries and/or joint secretaries from the ICT ministries of the SASEC countries, and representatives of development partners, is responsible for the identification and implementation of country and regional projects in the ICT sector. Such projects are in line with an ICT master plan formulated by the ICTWG (see 'The SASEC Information Highway Project').

DIGITAL CONTENT AND ONLINE SERVICES

The SAARC Audio-Visual Exchange (SAVE) program is one of the earliest digital content initiatives in the region. Launched in November 1987 during the 3rd SAARC Summit in Kathmandu, the SAVE program includes exchange of audio-visual materials as well as joint audio-visual productions on thematic issues concerning the environment, disabled persons, youth, literacy, participatory governance, safe and clean water, mountains and hills, and the like.

SAIC is mandated to build a regional network of information centres in the Member States and foster the exchange of re-gionally generated technical information to strengthen agri-cultural research, development, and innovation. To this end, SAIC produces audiovisual materials and videos in Beta-cam, DV-cam, and Hi-band formats on various subjects. The SAIC Video Library consists of more than 110 videos in a Video Home System (VHS) format produced by the member states. Audio-visual collected by SAIC are reproduced in a video compact disc (VCD) format and print materials photocopied for distribution to institutions and to people whenever requests for information are received.

SAIC also maintains Compact Disc-Read Only Memory (CD-ROM) databases of the Agricultural Bibliographic In-formation Service (ABIS). The internationally procured CD-ROM databases are updated regularly. They include: CAB ABSTRACTS (1990–2005); Crop science database (1973–2003); AGRICOLA (1970–2005); FSTA (1990–2005); PG and breeding database (1973–2005); BEAST CD (1973–1999); Veterinary science database (1973–2003); soil science database (1973–2003); forest science database (1972–2004); horticultural science database (1973–2003); parasitology database (1972–2005); AGRIS (2004); and biological abstracts (1995–1997).

The SAICNet program provides access to agricultural in-formation through a Web-based information network. This net-working service enhances the existing agricultural knowledge and information systems of the SAARC Member States and provides a platform for the exchange of ideas, information, and knowledge.

The SASEC Information Highway Project

The SASEC ICT Development Master Plan was formulated in 2001 with the support of the Asian Development Bank (ADB). A key project under the master plan is the SASEC Information Highway. The project, which has three components, is the first multi-country investment project in South Asia supported by the ADB. Its first component is the establishment of the SASEC regional network to integrate member countries and reduce Internet costs, particularly for the landlocked countries of Bhutan and Nepal. The second component is building the SASEC village network to expand broadband wireless connectivity to rural communities and enable them to better access services such as telemedicine, distance learning, and e-government services. The third component is establishing the SASEC regional research and training network of communities, businesses, and research institutes, to facilitate the flow and integration of information, knowledge, and services among member countries. These networks will be established and operated through a public-private partnership with a strong focus on entrepreneurship.

Also in line with its ICT Master Plan, the ICTWG has implemented the Community e-Centres (CeCs) project, which aims to bridge the digital divide between rural and urban communities by establishing telecentres in rural villages in SASEC participating countries. The project has received support from the ADB and the United Nations Economic and Social Commission for the Asia and the Pacific (UN ESCAP).

(Source: Asian Development Bank 2007)

Also worth mentioning is the work of the SDC to enable exchange of information in the biological, physical, chemical, engineering, and life sciences, as well as in developmental matters. The documentation system consists of a central facility (i.e. SDC) and national focal points in all the member states, which act as repositories.

At the first meeting of the information ministers in Dhaka held in April 1998, the SAARC strategy for sub-regional cooperation in media and information was adopted with the following objectives:

- To actively encourage greater flow of information in the SAARC region on all issues of common concern to member countries for the promotion of peace and harmony in South Asia as well as sustained development of the region;

- To generate, disseminate, and exchange information materials in support of SAARC and all SAARC initiatives in important areas, with special emphasis on trade and investment, social and cultural development, functional cooperation, environmental protection, and HRD;

- To promote the optimal utilization of available resources and facilities in the SAARC region to strengthen cooperation in the field of media and information and upgrade the professionalism of media persons through HRD programs and regional exchanges;

- To initiate collective regional actions to enable member countries to fully benefit from the use of new technologies to ensure greater flow of information within the region and between South Asia and the outside world; and

- To consistently work to project and promote a positive image of SAARC abroad as well as provide regular information on specific SAARC initiatives.

To achieve these objectives, the Information Ministers agreed to implement the 18-point SAARC Plan of Action on Information and Media (PAIM), which promotes cooperation to:

- ensure the free flow of information, newspapers, periodicals, books, and other publications;

- reduce postal and telecommunication rates for media transmission and information materials;

- increase cooperation among news agencies of SAARC countries;

- facilitate easier travel for media persons within the region;

- work toward the evolution of a SAARC-recognized regional media forum;

- hold an annual conference of editors and working journalists from SAARC countries;

- create a Web page for exchange of news among news agencies of SAARC countries;

- enhance exchange of data through email and the Internet;

- arrange regular exchange of TV and radio programs;

- organize regular exchange and joint production of documentaries and films as well as periodic SAARC film festivals;

- arrange training for media persons of SAARC countries;

- include SAARC orientation modules in the syllabi of national media training institutes;

- improve programs under SAVE by making them more attractive and popular and increasing their frequency;

- hold annual meetings of heads of national TV and radio organizations to review the SAVE programs;

- evolve model guidelines on trans-national satellite broadcasting in the region;

- examine the financial and technical feasibility of establishing a SAARC satellite;

- explore the feasibility of setting up a SAARC Information Centre with media production, research and training units, as well as a SAARC Media Development Fund; and

- discourage negative projection of member countries by media in SAARC countries.

In general, SAARC has been slow to implement the PAIM. However, it set up the SIC in Kathmandu in May 2005. The SIC serves as a regional information hub, acting as a nodal agency for the collection of information about SAARC and its member states. It coordinates radio and television (TV) productions; facilitates research and conducts training and skill transfer activities; acts as an information bank for SAARC and its members; forges stronger intra-regional links for cooperation and collaboration among the media of the SAARC countries; and interacts with the SAVE, the SAARC regional centres, the SAARC apex, and recognized bodies and other programs within SAARC. In addition, the SIC maintains a database covering economic, social, and other information on the region and a library of various programs on core areas of cooperation, and makes the information available to the member countries through the Internet.

ICT CAPACITY-BUILDING AND RESEARCH AND DEVELOPMENT INITIATIVES

As discussed, although some of the SAARC regional centres have been conducting HRD activities, in general SAARC's capacity-building with respect to infrastructure and HRD in the ICT and ICTD sectors has not been significant. There are plans in this regard, such as the PAT 2004, but these have not been implemented in a systematic and sustained manner.

The same may be said of SAARC's performance in R&D in ICT and ICTD. Unlike the SASEC, which has developed a master plan on ICT, neither the SAARC nor its regional centres have been observed to have done the same. At the most recent SAARC Summit held in 2007 in Delhi, one of the declarations adopted had to do with the development of a telemedicine network in South Asia. How this will develop in the years to come is eagerly anticipated.

However, there are regional R&D efforts involving South Asian countries outside of the ambit of SAARC itself. One of the most significant is the PAN Localization Project supported by the International Development Research Centre (IDRC) of Canada (see 'PAN Localization: Building Local Language Computing Capacity in Asia Project').

CHALLENGES AND OPPORTUNITIES

Given that one-third of the world's population and almost half of the world's poor inhabit South Asian countries, and given the internationally recognized strengths of the ICT sector of some countries in the region, notably India and Sri Lanka, the challenge for SAARC is how to harness ICT to help reduce poverty in South Asia. How can SAARC facilitate cooperation among the member countries for the development of the ICT and ICTD sectors to accelerate regional economic and social development?

Finding precise answers to these questions is not easy. But this review of what SAARC has done so far suggests some action points, starting with following up and monitoring the implementation of policies and plans adopted at the SAARC Summits. SAARC should also follow through on its position paper at the WSIS Summit, particularly its statement about developing a regional policy on ICTD in South Asia.

SAARC might also consider forming a functional and effective technical committee and/or a regional centre for ICT and ICTD sector development in South Asia. This should work in tandem with other SAARC Regional Centres on infrastructure and HRD, as well as research in ICT and ICTD in South Asian countries.

PAN Localization: Building Local Language Computing Capacity in Asia Project

In collaboration with the Centre for Research in Urdu Language Processing (CRULP) in Lahore, Pakistan, the Pan Asia Networking (PAN) Programme of the International Development Research Centre (IDRC) of Canada is helping to generate tools to translate Internet content into local languages, build capacity for local language computing, and advance policy for local language content creation and access across Asia. This includes the development of character sets, fonts, spelling and grammar checkers, speech recognition systems, machine translation, and other related local language applications.

The project involves six South Asian countries, namely, Afghanistan, Bangladesh, Bhutan, Nepal, Pakistan, and Sri Lanka. Its main goal is to develop a process framework for local language computing development. In this connection, the project:

- Conducts research into linguistics, computing, and language processing for selected local languages;
- Develops training material and provides training in local language computing;
- Develops computer standards and software that enable local language computing;
- Experiments with marketing strategies to promote the use of local language tools for content development;
- Nurtures a regional network of researchers, practitioners, and policymakers for collaborative learning in local language computing;
- Consolidates a regional platform and voice on local language computing issues; and
- Contributes to the state-of-practice in local language computing through a rigorous research publication program.

Many countries participating in this project have been able to develop and standardize local fonts, for example in Nepali (Nepal), Bangla (Bangladesh), and Urdu (Pakistan). The challenge for this project is how to build the capacity of the local communities to benefit from these localized fonts.

(Source: International Development Research Centre 2007)

Separately or in tandem with the SASEC, SAARC could develop an ICTD Master Plan or a SAARC ICT and ICTD Strategy.

Finally, SAARC could explore setting up a fund for ICT and ICTD sector development in South Asia, along the lines of the funding mechanism created by the Association of Southeast Asian Nations (ASEAN) after its 7th ASEAN TELMIN. The ASEAN ICT Fund comes from a USD 100,000 annual contribution by each member country over a period of five years ending in 2010. For 2007–2008, USD 45,000 was allocated to each of the 11 approved projects of the various ASEAN Working Groups. Similarly, SAARC should be able to work with international donors and agencies to put in place a funding mechanism for ICT and ICTD sector development in South Asia.

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Part D

Review of individual economies

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Afghanistan

Muhammad Aimal **Marjan**

INTRODUCTION

Information and communication technology (ICT) is an important part of the infrastructure of any country and it plays a vital role in the growth of any economy. Recognizing its importance, the Government of Afghanistan has placed ICT development under pillar three — Economic and Social Development: Infrastructure and Natural Resources — of the Afghanistan National Development Strategy (ANDS) (2008). ICT will enable the Afghan government to successfully execute its broad reconstruction effort. A modern telecommunications sector and e-government initiatives will enhance the effectiveness, efficiency and transparency of the public sector and the provisioning of social services.

Today when the telecommunication revolution has reduced the world to a global village and its development is important for Afghanistan as well. All Afghan communities face the 'tyranny of distance' and the alienation associated with remote geographic conditions. Afghan women in particular face restriction of movement due to security concerns and conservative traditions. To restore cultural and social normalcy throughout the country, it is essential that all 34 provinces, 365 districts, and over 6,000 villages and rural areas are integrated with each other, Kabul, and the rest of the world. ICT could be the basic enabler of the informal social and economic discourse necessary for the strengthening of civil society and the promotion of economic activity (e.g. access to markets and pricing).

ICT is necessary for the resumption of productive capacity and stimulating activity in all sectors of the Afghan economy. It plays a critical role in re-establishing basic economic linkages by relieving communication bottlenecks in financial, governmental, and cultural information flows. In addition, ICT use, particularly in Government-to-Government (G2G), Government-to-Business (G2B), and Government-to-Citizen (G2C) services, can facilitate the administrative reforms that are considered to be one of the major challenges for the government of Afghanistan.

In short, the ICT sector has a crucial role to play in economic growth, poverty reduction, and the overall development of the Afghan nation.

TECHNOLOGICAL INFRASTRUCTURE

Over the last half decade there has been significant progress in putting in place the ICT and telecom infrastructure of Afghanistan. Both the private and public sectors have contributed to the build-up of this infrastructure.

A 3,600 kilometre national fibre optic backbone following the national ring-road infrastructure is being installed, connecting 16 of 34 provinces to the Trans Asia Europe (TAE) and South East Asia–Middle East–Western Europe (SEA–ME–WE) submarine cable system through Iran, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan. The network will have a capacity of 36 STM4. The construction started in 2007 and is expected to be completed by March 2009. At present domestic and international voice and data communication is based on satellite, which is very expensive and low in quality. With the completion of the network, both domestic and international connectivity will be shifted from satellite to the fibre optic ring. The project has regional importance as the Central Asian countries do not have a direct connection with the SEA–ME–WE, and their call route to the

rest of Asia is currently via Europe. The fibre ring will serve as a bridge, which will lower the cost of international calls for Central Asian as well as European countries.

At present the provincial capitals and government ministries are connected through C-Band very small aperture terminal (VSAT), microwave and fibre optic (for Kabul only) for data, voice, and video conferencing services through the government communication network completed in 2007. A 3.6 MHz World-wide Interoperability for Microwave Access (WiMAX)-based network has been established to connect the offices of the pro-vincial governor, other government offices, and hospitals in the provinces. Thirty-four governor's offices will be connected by mid-2009. Sixty-nine percent (or 252 out of 365) of district capitals are connected through KU-Band VSAT terminals for voice, Internet access, and fax services.

In 2007, GSM coverage was also extended to most of these districts by various operators. The networks have played a major role in connecting Afghans scattered in different parts of the country and the world, improving their social ties and eco-nomic and security conditions. The four GSM and one fixed line operator provide services to seven million subscribers, which is equivalent to a penetration rate of 32 percent of the population. Close to 2,576 telecom base stations are now installed, making telecom services possible in more than 250 cities, towns, and populated areas, and bringing 75 percent of the population under

telecom coverage. Local call prices dropped from USD 0.30 in 2002 to USD 0.02 in December 2007. International call prices went down from USD 1.80 in 2002 to USD 0.20 in December 2007. SIM prices too dropped from USD 300 in 2002 to USD 1 in December 2007.

As the existing telecom services provided by operators are focused in the urban areas, the Village Communication Network (VCN) is now being pursued to bridge the divide between urban and rural areas. VCN will connect 6,000 villages through public-private partnerships (PPP) with a capital investment of USD 2,000.00 per VCN by the local owner. Each VCN node will have a KU band VSAT powered by solar energy.

The private sector is also active in building Afghanistan's telecom infrastructure. The Afghan Wireless Communication Company (AWCC) has established a 2,500 kilometre nationwide microwave ring covering 31 provinces and more than 250 towns, cities, and highways with a minimum capacity of STM1 con-nectivity expandable to 155 Mbps. The AWCC offers roaming services in 124 countries and 353 networks worldwide.

The Afghanistan National Data Centre (ANDC), which will be ready by June 2009 with an initial capacity of 40 Terabytes, will host e-Afghanistan, consisting of e-government applications. By end 2009, the National Internet Exchange of Afghanistan will be established as a PPP involving local Internet service providers (ISPs) and data network owners (see 'Internet Penetration in Afghanistan').

Internet Penetration in Afghanistan

About 500,000 people were subscribed to the Internet as of October 2007, which is equivalent to a penetration rate of 2 percent (up from 1 percent in 2006). Seventy-eight percent of subscribers are from the foreign missions and the NGO community in Afghanistan. Individuals comprise 10 percent, Internet cafés 7 percent, and government 5 percent of Internet subscribers.

Non-government organizations (NGOs) are utilizing the Internet for financial, project tracking, and MIS applications. The number of public Internet cafés is increasing. However, there is an imbalance in the number of Internet cafés in urban and rural areas of the country, with more than 60 cafés in Kabul and only one in Farah, a province in the South, for example.

GPRS services were launched by the GSM operators in January 2007, enabling Afghans to access the Internet over their mobile phones.

The Internet penetration in Afghanistan is low because of the limited availability of electricity in the country (households in Kabul have five hours of electricity per day), the lack of local content, and the high cost of bandwidth. In addition, there is a lack of local access networks. The government and the private sector are investing in the installation of local access networks and last mile connectivity. It is expected that the fibre and copper cable installation initiatives will improve conditions toward the end of 2009.

(Source: Altai Consulting 2007)

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

In February 2007, the Afghan Cabinet approved the renaming of the Ministry of Communications to the Ministry of Communications and Information Technology (MCIT) as an acknowledgement of the central role that ICT will play in accelerating Afghanistan's full participation in the global information society. The MCIT will provide strategic leadership in the development of the ICT sector, and it will act as the focal point for all of the stakeholders to help shape future policies and promote large-scale projects.

In May 2007, the ICT Council was established by Presidential Decree as the primary forum for all of stakeholders. It is expected to play a major role in the promotion of ICT and e-governance in Afghanistan. The ICT Council includes representatives of government ministries, business (service providers), civil society (relevant associations), and academia. It is chaired by the first vice president. In 2008 the Council held three meetings where the main issues in current and future ICT development in Afghanistan were discussed. The Council has agreed to support the MCIT and Ministry of Interior in introducing the smart card/electronic ID card in Afghanistan in the next three years. The Council has also discussed the introduction of other e-services, in particular land titling.

The Afghanistan Telecom Regulatory Authority (ATRA, http://www.atra.gov.af) was established in December 2006 as an independent regulator responsible for telecom sector regulation in Afghanistan.

The Afghanistan Computer Science Association (ACSA, http://www.acsa.org.af), a non-profit and non-political computer world trust founded in 1999, aims to introduce computer science and ICT to the Afghan nation. The Association has undertaken the localization of MS Windows XP and MS Office 2003, which has helped ordinary Afghans to use computers in their daily activities. Open source products, such as the Sea Monkey suite, are also being localized. The Association is also actively involved in raising ICT awareness, promoting Internet policy, regulatory reform, and capacity-building.

The National ICT Alliance of Afghanistan (NICTAA) is an umbrella organization and a strong voice for ICT in Afghanistan. Founded in 2007 by 11 leading ICT associations and companies known as the Founding Members of the Alliance,[1] it represents the four major pillars of the ICT sector, namely, private companies, professionals, academia, and consumers.

The National ISP Association of Afghanistan (NISPAA) was established in 2006 by ACSA and Internews Europe. The organization has nine ISPs as members.

Established in 1999, the Afghan Media International (AMN) has a range of programs, such as national and international media support, research, training, journalists' information, freedom of speech, and human rights.

Afghanistan will have an operational Electronic Certification Authority by the end of 2009, which will enable the implementation of e-commerce and e-banking.

ICT AND ICT-RELATED INDUSTRIES

The ICT sector in Afghanistan is only six years old, but it has developed dramatically compared to the ICT sectors of neighbouring countries. Active ICT industries and related markets in the country include services (software/database development, website and Web hosting, IT consulting, and IT support); infrastructure and hardware (hardware sales, public and private infrastructure); telecom (telecom operators, mobile repair services, and telecom dealers); and Internet services (ISPs and Internet cafés). The total telecom market value at present is USD 1.3 billion, with foreign direct investment (FDI) amounting to USD 1 billion.

The share of local companies in the market is very small, as they are quite new. However, there is increasing evidence of local entrepreneurship, particularly in software/database and website development, Internet cafés, hardware sales, mobile repair services, and IT support. The government is establishing an ICT Park by mid-2010 and it is hoped that this facility will support local entrepreneurship.

KEY ICT POLICIES AND STRATEGIES

As described in the chapters on Afghanistan in previous editions of the *Digital Review of Asia Pacific*, a number of policies and regulations have been put in place for the promotion and development of the ICT sector. These policies have encouraged the private sector to invest in the telecom sector, with FDI reaching USD 1 billion by end of 2007. The focus of policies and investments has been on physical infrastructure and basic telecom services, and ICT applications have not received attention.

As the country is getting ready for the second round of presidential and parliamentary elections in mid-2009, the

government is drafting new development policies and strategies to be handed over to the next government under ANDS. The government endorsed the Strategy at the Paris conference held on 12 June 2008.

The government is working on attracting business process outsourcing, help desk, and call centre businesses to the country to give Afghan women opportunities to work from home and be economically productive without offending cultural sensitivities. This activity will also help in the drive against narcotics and terrorism in Afghanistan since low employment is one of the factors giving rise to terrorism and the trade in narcotics.

The adoption of the e-Afghanistan program in the context of ANDS is envisioned to help the country overcome corruption, improve government efficiency, and strengthen the rule of law. As part of the program, all government ministries and governor's offices will have an online presence by end 2009.

The ICT sector strategy also encompasses regional cooperation through the fibre ring, national data centre, local content development, regional data repositories, regional cybercrime, regional data interconnection, and other similar projects and activities positioning Afghanistan as a central point in the region.

Several policies have contributed to ICT sector development in Afghanistan. One of these is the ICT Policy adopted in November 2003 with three objectives: *(i)* use ICT to improve government services and promote e-government; *(ii)* rehabilitate existing infrastructure and build new infrastructure; and *(iii)* develop the National ICT Council of Afghanistan.

The Telecom Policy was also adopted in November 2003 with the objective of creating an enabling regulatory environment and promoting fair competition, encouraging private investment and market liberalization, and encouraging widespread adoption of ICT.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The Telecommunications Services Regulation Act was adopted in December 2005, paving the way for the establishment of ATRA as an independent regulatory body. The Telecom Law empowers ATRA to implement regulations and normative acts. Generally, these regulations fall into the following three categories, pursuant to ATRA's own Code of Procedure, which was adopted in October 2006:

1. Administrative rules (hiring, firing, documentation)
2. Procedural rules (public consultations, rule-making, appeal)
3. Substantive rules (licencing obligations, consumer protection).

To reach underserved areas, the Telecom Development Fund (TDF) was established under the Telecom Law. It will be used to help telecom operators rollout telecom services to the rural areas.

The MCIT has also just started drafting the ICT Law, which will address issues such as legal recognition of electronic/digital signatures and formulation of electronic contracts, content regulation, competition regulation, electronic evidence, data privacy protection, consumer protection and rights, domain name registration and regulation, intellectual property rights, encryption and security, financial and banking sector law and regulation relating to electronic transfers and settlements, taxation of transfers, customs, jurisdiction, dispute resolution and civil and criminal offences, limitations of liability of ISPs, cyber piracy and digital rights management, facilitation of e-government and cross border interoperability of e-commerce frameworks affecting trade. The target is to complete the draft and get the law approved by the Parliament by end 2009.

The Intellectual Property Law, which is expected to be passed by mid-2009, aims to help encourage FDI in the ICT, print, and electronic media sectors.

The e-Government Interoperability Framework of Afghanistan will be ready by the end of 2009. It will put in place a framework and standards, including context, technical content, process documentation and implementation, and compliance regimes, for e-government in Afghanistan.

DIGITAL CONTENT

ACSA, in collaboration with the MCIT and Microsoft, completed the Pashto version of Microsoft Windows XP and Office 2003 in December 2007. ACSA is now localizing Microsoft Windows Vista and Office 2007. Work on font, lexicon, and spell check development is ongoing. The ACSA team has likewise prepared the initial feasibility report and produced the localized version of International Domain Names in the Pashto language. All of these are expected to boost the capacity of the Afghan people to develop digital content.

Today there are about 70 independent radio stations, 15 television channels, and 500 printed publications whereas six years ago there was only one radio station and it was operated by the Taliban. And while in the last four years most of the broadcast content was of Indian, Iranian or Pakistani origin, beginning in 2007 local TV channels have started presenting Afghan-produced TV dramas and short films, which is an indication of the local capacity to develop local content.

Over the past three years, the availability of local online news has improved considerably. Some online news services are www.benawa.com, www.pajhwok.com, www.tolafghan.com, www.larawbar.com, www.bakhtarnews.com.af, and www.wakht.com.

A number of cultural websites are also available, such as www.worbal.com, www.dastanona.com, www.sabawoon.com, www.realafghan.com, www.afghanan.net, www.afghanpost.com, www.hewad.com, www.mastana.net.

There are more than 1,570 domain names registered under the .af domain, and this number is increasing.

ONLINE SERVICES

In June 2007, the first telemedicine project was launched at the French Medical Institute for Children (in FMIC), one of the local hospitals. Using broadband technology, wireless video consultation, and digital image transfer, the telemedicine project will provide hospitals in Afghanistan with real-time access to specialist diagnosis, treatment, and training expertise from abroad.

One year later, in June 2008, the Afghan government initiated a project to implement the smart card concept in Afghanistan, starting with the electronic national ID to serve as the platform for electronic driving licences, electronic academic records, and electronic health records. The first phase of the project will be completed in 2011.

Over the last three years the banking sector has enjoyed tremendous growth, with 15 private banks licenced to operate. The assets of these banks grew from USD 262 million in 2004 to USD 1.8 billion in 2008. ATM services and internationally accepted credit and debit cards are available for Afghans through these banks. With the expected approval of the ICT Law the local banks will soon be able to open merchant accounts, making it relatively easy to set up an e-commerce business in Afghanistan.

In February 2008 Roshan, one of the local GSM operators, started the first mobile money transfer system in the country. Branded M-Paisa, the service is a mobile technology platform that provides financial services for those without access to banking. Its aim is to foster economic activity in the region.

The Afghanistan financial management information system, electronic human resource system for government offices, verified payroll payment, and other such electronic applications have been deployed over the last two years.

Two other online services are www.tohfa.af, where one can place an order to send gifts anywhere in Afghanistan, and www.jobs.com.af, which is contributing a lot to the job market in the country.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

Three decades of conflict and political unrest have destroyed the Afghan education system. In 2001, after the fall of the Taliban, the net enrolment ratio was estimated at 43 percent for boys and 3 percent for girls. There were approximately 21,000 (largely under-educated) teachers for a school age population estimated at six million. Females were forbidden to either attend school or to teach in the five years of Taliban rule. But the situation is gradually improving.

Several new institutions have been established by the government and the private sector to strengthen the education sector. Among these are the University of Afghanistan (www.universityofafghanistan.com), Afghan American University (www.auaf.edu.af), Kardan University (www.kardan.edu.af), Bakhtar University (www.bakhtar.edu.af), Aryana University (www.aryanauniversity.com), Afghan Pooshesh Training Institute (www.apti-af.com), and ICT Institute (ICTI) Kabul.

The new curriculum being developed will have computer education as a subject from class (grade) 4 to class 12 in schools. In addition, the MCIT and Ministry of Education signed a memorandum of understanding with the One Laptop per Child (OLPC) organization in May 2008, which provides for the deployment of 10,000 XO machines in Afghan schools in 2009. The MCIT and the Ministry of Education (MoE) are developing an e-learning strategy that covers the utilization of ICT in education delivery, ICT curricula, and the establishment of e-learning centres.

Also worth mentioning is the Afghan Institute of Learning (AIL), a women-led NGO that uses a creative approach to meet the health and education needs of Afghan women, children and communities, and provides ICT training at its IT centres. The training lasts from two to 10 weeks and covers basic computer skills such as word processing and use of spreadsheets.

OPEN SOURCE INITIATIVES

The open source sector in Afghanistan is very weak. There are a few private organizations working on open source platforms, including Paiwastoon Networking Service Ltd (www.paiwastoon.com.af) and Xala Technologies (www.xala.af). In April 2008, Linux Afghanistan (www.linux.af), a group of open source activists, was formed.

ICT RESEARCH AND DEVELOPMENT

The MCIT is planning to establish an e-government resource centre in 2010. It will serve as the government's ICT research and development (R&D) wing.

The Afghanistan Management Information Services (AIMS, www.aims.org.af) is also heavily involved in R&D in the area of software quality assurance and database standards, among others.

CHALLENGES AND OPPORTUNITIES

Over the past five years, Afghanistan has made major strides in the rollout of the telecom infrastructure and in building an environment conducive to the growth of the private sector. The government's decision to adopt new technologies for the delivery of public services is also a step in the right direction. The absence of legacy systems in most of the departments and the ongoing business process reengineering in the Civil Service Commission contribute to a favourable environment for the implementation of e-government.

Developing an ICT industry is something to be aimed for, given the country's human resources that can be trained to operate call centres, business process outsourcing companies, off-shore data entry, and the like. However, certain challenges will have to be addressed, namely, the security problems, lack of a stable political system, limited supply of electricity, and lack of skilled personnel in general and ICT professionals in particular.

Even as the country is struggling to address these challenges, progress is slowly being made in different areas, such as in the banking, health and telecom sectors, road construction, and secondary education. The Government of Afghanistan and the international community renewed their commitment to the country's development during the Paris Conference held on 12 July 2008. The Afghanistan National Development Strategy presented and approved during the Conference provides a well-defined and concrete road map toward a prosperous and stable Afghanistan.

NOTE

1. The NICTAA Founding Members are Afghan Computer Science Association (ACSA), Afghan Media International (AMN), South Asia Free Media Association (SAFMA) Afghanistan, National ISP Association of Afghanistan (NISPAA), Afghan Telecom, Afghan Wireless Communication Company, Alcatel-Lucent (ALU) Afghanistan, American University of Afghanistan (AUAF), Kardan University, MTN Afghanistan and Telecom Development Company of Afghanistan (TDCA)/Roshan.

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Australia

Lelia **Green** and Axel **Bruns**

INTRODUCTION

At a time when many liberal democracies are facing currencies in relative decline, reducing interest rates and gearing up for recession, Australia continues to hope to survive the downturn with what has been termed the 'two-track' economy. This economy features high growth in the mining and raw materials industries and marginal growth in other sectors. Queensland and Western Australia in particular are the beneficiaries of this dynamic. Unemployment in general is low, and there is a shortage of skilled people, including tradespeople, nursing and medical staff and teachers. Less skilled and unemployed Australians are most disadvantaged by the boom since they face rising rents, food and fuel prices particularly in the boom states.

Australia's wealth is based on its exports particularly to growing markets in Southeast Asia and India, but it also has a thriving knowledge economy that is highly dependent on ICT. The growing value of the Australian currency is making knowledge and information services, such as education and consultancy, more expensive to customers overseas. Aware that other markets are emerging in the information sectors, that the resources boom is staggering and might collapse, and that global fears about climate change might bring that day forward, Australians are searching for ways to build sustainable industries of benefit to the nation and to the region.

While the economic fortunes of Australia have been comparatively stable due to its mineral deposits, the political landscape changed significantly at the end of 2007. At that point the Howard government, a coalition of conservative parties, ended 11 years of rule, handing over to Kevin Rudd's Labor government. The first act of the Rudd government on 3 December 2007 was to ratify the Kyoto Protocol on Climate Change, 10 years after it had been agreed internationally. This was a symbolic statement of change because the Howard government, although a signatory, had refused to ratify and implement the Kyoto Protocol. There was a further break with the past on the first sitting day of the new Parliament. On 13 February 2008, Prime Minister Rudd delivered a National Apology to the Stolen Generations of Australia's Aboriginal and Torres Straits Islander peoples. The phrase 'Stolen Generations' refers to government policies across a century or more (until the 1970s in some places) of removing indigenous children from their parents and bringing them up in missions and institutions. The children were frequently trained for work in the wider society as domestic and household servants. Aboriginal and Torres Straits Islander people had requested the apology, but the Howard government had refused to make it.

In addition to their commitment to environmental responsibility and social justice, the Labor government has promised major initiatives in high-speed broadband and an 'education revolution' (including a laptop for all school children between 9 and 12 years of age), and it called for a 2020 summit to bring together Australians with different perspectives and from different backgrounds to reflect upon the kind of nation they would like to have in a decade's time, and how to get there.

Australia is the world's largest island, and the only island continent. On 21 April 2008 the United Nations responded to a 2004 claim and recognized Australia's extended boundaries in line with its continental shelf. This made a huge impact in terms of overall area: some 2.5 million additional square kilometres of the sea bed immediately became Australian territory. Given its

size, Australia has a comparatively small population. This is partly because so much of the land cannot be used for agriculture or settlement. Additionally, the country is still suffering from the worst drought on record and most population centres continue to restrict the use of water, especially for gardens and recreational purposes.

Australia is highly urbanized with the vast majority of the population living in cities. Only 3 percent of the population is defined as settled in remote areas. Also, 80 percent of Australians live within 50 kilometres of the sea (Dale 2006). One of the implications of this unbalanced spread of the population is that it is particularly difficult and expensive to connect the few people living in remote areas to good quality digital services, and thus there is a significant digital divide although Australia is a comparatively wealthy country. The Howard government set up an AUD 2 billion (USD 1.35 billion) Communications Fund to support improved telecommunications in the bush, and they paid for this through the sale of Telstra, the national telecommunications carrier. This fund has now been earmarked for general improvements to deliver high-speed broadband to approximately 98 percent of the population, leaving aside the very people for whom the fund was created.

TECHNOLOGY INFRASTRUCTURE

Although Australians think they have good technological infrastructure, it stops well short of the fibre-to-the-home (FTTH) network that would be required for a full range of fibre-based digital interactivity at world class speeds. The Labor Party, then in opposition (2007), argued that at AUD 4.7 billion their fibre-to-the-node (FTTN) plan was the 'most expensive election pledge' ever. The implication is that it is too expensive to connect all Australian homes by fibre. Nevertheless, some consumers are hoping for greater speed and service and they suggest that FTTN may be a first step toward FTTH, even if this further advance is only feasible in Australia's towns and cities.

Critics have suggested that the promised speeds are disappointing and that the plan's integrity has been compromised by the use of statistics and scenarios generated by Telstra. Previously the publicly-owned monopoly telecommunications provider, Telstra is now fully privatized although a government-regulated entity, known as the Future Fund, set up to support the cost of pensions for Australia's aging population, still holds a 17 percent share. The proposed plan is a revisitation of older partnership plans whereby private companies would provide the infrastructure to the populous areas and the government funding would make feasible the rollout of services to most regional, remote, and rural communities. The intention is to cover 98 percent of Australian businesses and homes with broadband

speeds of at least 12 Mbps, and use the Future Fund to finance over half of the AUD 4.7 billion in government funding. Two entities are fighting for the rights to partner the government in this endeavour. Telstra was first to propose a partnership arrangement but it withdrew its initial offer arguing that the competition regime under which they would be required to offer their competitors access to the network put them at a market disadvantage. The opposition is an Optus-led consortium, Telstra's major competitors that have banded together to develop a nationally competitive proposal to match Telstra as the giant in the market. Ultimately, the Telstra bid was eliminated on a technicality and the rollout has been delayed indefinitely (see 'ICT and the November 2007 Federal Election').[1]

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

In December 2007, a fortnight after the defeat of the conservative Howard coalition government, the national Department of Communication, Information Technology and the Arts (DCITA) was subsumed within the Department of Broadband, Communications and the Digital Economy (http://www.dbcde. gov.au/). This move signalled two major messages: first, that broadband is of primary importance to the government; and second, that the digital economy would have a major new focus. (At the same time, the Arts portfolio was transferred to the Department of Environment, Water, Heritage, and the Arts.) DBCDE (the new shorthand for the Department of Broadband, Communications and the Digital Economy) is responsible for government services (information, regulation, policy, statistics, research, reviews, security, contacts, etc.), communications and technology, and media and broadcasting. Representing Australia in international policy and decision-making forums concerning the national interest in terms of broadband and the digital economy, DBCDE collaborates with the Department of Foreign Affairs and Trade (DFAT) when it comes to exports and access to foreign markets.

The Australian Government Information Management Office (AGIMO, http://www.agimo.gov.au/), which is part of the Department of Finance and Deregulation, is charged with ensuring that Australia uses ICT to improve government administration. Its website includes a 'Better Practice Centre' that showcases particularly effective initiatives, and celebrates case studies of finalists in the 'Excellence in e-Government Awards'. The range of publications available for free download includes *Responsive government: A new service agenda* (AGIMO 2006), which looks forward to 2010 and has four key focus areas: meeting users' needs; establishing connected service delivery;

ICT and the November 2007 Federal Election

Where previous federal election campaigns had been conducted primarily through the traditional media of print and broadcast, in 2007 the Internet played a significant role in the election media mix. Parties, candidates, and media organizations used the Internet to engage citizens in interactive exchanges. Voters also took the opportunity to make their voices heard more loudly, particularly with the help of a progressive new voice in Australian politics, GetUp (http://www. getup.org.au/), an independent, grassroots community advocating Australian citizen involvement in and holding politicians accountable on important issues. *YouTube* reached a new prominence as a site for the conservative Liberal party to release short 'address to the nation'-style video clips featuring then Prime Minister John Howard (see Bruns et al. 2007). With both party leaders packing their punches on *YouTube*, the wags commented that it would be good when all Australia had the broadband speeds necessary to watch them.

Australian mainstream media became obsessed with electoral polling data. In response, a number of high-profile psephology blogs and websites emerged (operated by scientists specializing in the analysis of electoral opinion data). These bloggers' consistent critiquing of mainstream news media coverage in general, and of the political analysis in leading national newspaper *The Australian* in particular, ultimately resulted in a thundering (and ill-advised) editorial denouncing the citizen psephologists as 'out of touch with ordinary views' and culminating in the remarkable claim that unlike them, 'we understand Newspoll because we own it' (*The Australian* 2007).

Youdecide2007.org (*YD07*) was a project that harnessed and encouraged citizen involvement in media and election debates. It was funded by the Australian Research Council and involved public service broadcaster SBS, Cisco Systems and the National Forum (which publishes the political commentary site *On Line Opinion*). *YD07* developed a hyper-local citizen journalism[2] coverage of the election by encouraging users to report political activities in their own electorate. It managed to provide coverage ranging across electorates as diverse as the inner-Brisbane seat of Griffith, won by incoming Prime Minister Rudd, and the remote Western Australian seat of Kalgoorlie, stretching across much of the state and (by size, not by residents) the largest single electorate in the world.

User-led political news sites such as *YD07* overcome what is often highlighted as a shortcoming of citizen journalism: they explicitly encourage their contributors to become active as journalists rather than simply as commentators. Indeed, one story emerging from a *YD07* interview with the Liberal member for Herbert — who had claimed that many 'young people today are financially illiterate' — became the basis for a question in Parliament by then-opposition leader Rudd during the last sitting weeks before the election, and helped spark a national debate about the personal credit crisis in Australia (Wilson 2007). While there were some unresolved issues, *YD07* points to a role for citizen-driven, bottom-up media forms in the emerging overall media mix of Australia as a networked society.

(Sources: Bruns et al. 2007; *The Australian* 2007; Wilson 2007)

achieving value for money; and enhancing public service capability. There has also been ongoing discussion and publications about environment-friendly ICT since 2004.

Although there has been a major change in terms of the names and composition of government ministries, most of the regulatory authorities are legislated to be at arm's length from government itself. The regulatory authorities tend not to change with the government. Set up by statute, the regulators are appointed for a fixed term and are considered for renewal or replacement at the end of that term. The major government regulator in the ICT field is the Australian Communications and Media Authority (ACMA, http://www.acma.gov.au/). The ACMA website offers a portal to information and regulation concerning broadcasting, the Internet, the radio frequency spectrum

and telecommunications. There are links to popular government initiatives to crack down on spam and to register private telephone numbers as 'do not call' lines, which prevents telemarketers from calling those numbers. ACMA also regulates radio, television and Internet content, and deals with complaints.

The Classification Board which classifies films, videos, games and some literature is separate from ACMA, and has only recently taken over from the Office of Film and Literature Classification (OFLC) set up in 1988. The Classification Board (http://www.classification.gov.au/) is also an independent statutory body. The Classification Board is supported by the Classification Operations Branch in the Attorney-General's Department so it is not independent in the sense that it is entirely constituted as a stand-alone entity. Appeals against a Classification Board ruling

are referred to the Classification Review Board, also supported by the Attorney-General's Department.

ICT AND ICT-RELATED INDUSTRIES

Although Australia is an importer of many high-tech goods, including ICT, it has a vibrant industry in high-end, value added and service-driven products. The ICT industry in Australia is worth AUD 90 billion (AIIA 2008), 4.6 percent of Australia's GDP (AIIA 2008; ACS n.d.) and 13.8 percent of total investment in Australia (ACS n.d.). The ICT sector employed 274,132 people in mid-2005 (ABS 2006). Foreign-owned companies account for 43 percent of employment and 60 percent of income (ACS n.d.). AIIA is one of the major industry organizations and its members are aligned with over 500 companies and account for AUD 40 billion in ICT revenues. AIIA International affiliates include the Asian-Oceanian Computing Industry Organisation, the World IT and Services Alliance, and the Asia Pacific ICT Alliance (with links through their regional award programs).

The other industry association for this market sector used to be the Australian Electrical and Electronic Manufacturers' Association (AEEMA), but at the start of 2008 AEEMA merged with the Australian Industry Group (AIG). Together, the AIG plus AEEMA market focus comprises: 'communications, connected homes, data capture, defence, digital broadcasting, electrical capture equipment, electronics (including components and micro-electronics), hazardous area equipment, home appliances and accessories, IT security, lighting, photonics, smart cards and transport telematics' (AIG 2008).

Not all ICT-related industries are legitimate. A priority for the new Minister for Trade is to follow the lead of Japan, the EU, Switzerland, and the US in the negotiation of an Anti-Counterfeiting Trade Agreement. This commitment arises out of a 2007 discussion paper and will address issues around pirated intellectual property, particularly in digital products such as games, music, films, and software. Estimating that the global value in physically traded pirated and counterfeit goods could have amounted to USD 200 billion in 2005, the government discussion paper adds that 'if domestic production and trade in infringing goods and digital piracy via the Internet were also to be included, the OECD report estimates the total value would be increased by several hundred billion US dollars' (DFAT 2007).

The Interactive Entertainment Association of Australia (IEAA) has published a recent report on 'Interactive Australia 2007: Facts About the Australian Computer and Video Game Industry' (IEAA 2007). Among other findings from over 1,600 randomly sampled telephone interviews and an online survey run by AC Nielsen Surveys Australia, results showed that 41 percent

of Australian gamers are female, 8 percent are seniors, and 79 percent of Australian households have a specialist device for video and computer gaming (IEAA 2007, p. 1), with many parents attributing a number of positive outcomes to their children's interactive game-playing, including learning about technology and maths and developing their capacity to plan ahead.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

In addition to the ICT promises made by the government in the Education Revolution policy (discussed in 'ICT-related Education and Capacity-building Programs', the Department for Education, Employment, and Workplace Relations (DEEWR, previously the Department for Education, Science and Training) maintains a searchable database of national and state-level ICT policies for education and training (DEST 2007). An outcome of the *Strategic Framework for the Information Economy* (DBCDE 2004), the database provides easy access to all current and recent (in the last 10 years or so) ICT initiatives related to education and the workforce.

The dual commitments by the new government to tackle FTTN infrastructure on the one hand and computer access for high school students on the other (see 'ICT-related Education and Capacity-building Programs'), constitute a policy pincer movement aiming for an increase in the speed and capacity of data transfer for almost all Australians and extensive exposure to ICT skills and education for the next generation of workers.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Funded by the federal DEEWR and its pre-election predecessors, the Open Access to Knowledge (OAK) Law Project (http://www.oaklaw.qut.edu.au/) hosted at Queensland University of Technology is a national leader in the field of Open Access policy development. It 'aims to ensure that every day citizens through to top-end researchers can legally and efficiently share knowledge across domains and across the world' (OAK Law Project 2008). It has already developed legal protocols to achieve that aim. In February 2008, it launched the OAKList (http://www.oaklist.qut.edu.au/), a '[W]eb-enabled database containing information about publishing agreements and publishers' open access policies' (OAKList 2008).

Creative Commons Australia (http://www.creativecommons.org.au/) is a related project to translate international Creative

Commons (CC) licence agreements into the Australian legal framework. At present, CC licence version 2.5 is already available in Australian variants and a draft of CCau v3.0 underwent public consultation in 2008. Additionally, Creative Commons Australia is increasingly involved in information and outreach projects in the wider Asia Pacific region.

Child protection is a major theme in Australian Internet regulation although opinion is divided between teaching children how and why to behave safely on the Internet — and how to respond to any troubling material that they may encounter — and filtering out all content that might be deemed unsuitable. Both strategies are in use. Additionally, there are Cyberpredator laws in some jurisdictions, such as in Western Australia, where specialist police officers pose as underage Internet users to catch people using the Internet to stalk or exploit Australian youngsters. Cyberpredators can be prosecuted if they are operating from within Australia. ACMA's online resources for adults monitoring children and their Internet use can be found at http://www.cybersmartkids.com.au/for-grown-ups.htm.

DIGITAL CONTENT

Because English is Australia's official language, there are few problems with digital resources for the majority of the population. However, there are few digital resources available in indigenous languages and the languages spoken by migrant groups.

Some websites are available in indigenous languages. One website, http://ninti.ngapartji.org/, includes a pay-to-learn program where mother tongue Ngapartji speakers work with professionals to provide resources for others to learn this indigenous Australian language. The Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS, http://www.aiatsis.gov.au/) is a government body under the DEEWR tasked with providing accessible resources on indigenous culture and society, including resources relating to lost and endangered languages.[3]

The Department of Immigration and Citizenship's website (http://www.dimia.gov.au/living-in-australia/help-with-english/index.htm) includes a 'Living in Australia' section with booklets (also available on the Web) in 24 community languages, and it provides details about interpreting and translating services available to refugees and new migrants. SBS Radio (http://www.radio.sbs.com.au/) broadcasts in 68 languages — more than any other broadcaster anywhere in the world. Special Broadcasting Services (SBS) also broadcasts a range of linguistically and culturally diverse television programming, and has a strong online presence.

ONLINE SERVICES

Online services in Australia are generally well developed. All major banks and businesses, and many minor businesses, offer online services of some form, including Internet banking, browsing and ordering facilities; feedback and support mechanisms; and many other service options. Trust in such services is generally high with over half of Australian Internet users subscribing to online banking since as far back as 2005 (DCITA 2005). Indeed, many major banks have reduced their network of physical bank branches in favour of online banking and other financial services. This strategy gives rise to equity issues for Australians who are unwilling or unable to switch to online service offerings.

Australian governments at all levels (local, state, and federal) have also made moves toward online services ranging from static or dynamic information sites to e-service and e-business options. Policymakers and service providers are exploring the potential for direct engagement with citizens that incorporates elements of Web 2.0 and social networking sites. For example, Future Melbourne was a project that utilized wiki technology to develop a vision for the city in the year 2020 in consultation with citizens (Future Melbourne 2008). Just-in-time delivery of information to phones and other mobile devices (e.g. weather information, traffic conditions) is also being adopted, as well as citizen reporting via short message service (SMS) or multimedia message system (MMS) to local authorities concerning potholes, graffiti, traffic accidents, and other incidents.

At their most basic, e-government sites act simply as a repository for government information, policy documents, press releases, and other content to be communicated to the public. Beyond this, government websites and Internet services offer opportunities to search for or request specific information; pay fees and fines; and provide feedback to department staff. Shortly before the November 2007 federal election, AGIMO released a discussion paper on the potential for creating an Australian federal government consultation blog that lists consultations and allows people to post responses, comments, and feedback. Although not a 'blog' as conventionally understood, such a consultation site could facilitate continuous conversation between citizens and government. The AGIMO paper also outlines some of the key challenges (of moderation, privacy, and security) associated with such a project.[4] A DBCDE trial *Digital Economy* blog took place in late 2008.

In this context it is also interesting to note that one of the key recommendations from the April 2008 '2020 Summit' of Australian thinkers, entrepreneurs, artists, and policymakers was the creation of a 'one-stop shop' portal to government services (at the federal level), provisionally titled www.your.gov.au.

Although the Summit's recommendations are not necessarily representative of wider public interest or binding for the federal government,[5] a central government services portal is likely to be viewed as a desirable initiative by a large proportion of the population.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

Building ICT capacity is a high priority for the Australian government, and one of the key election promises in the new government's 'Education Revolution' policy was to provide a dedicated school computer for every child enrolled at an Australian secondary school (years 9–12, ages 14–17). This initiative is to be funded by a 'National Secondary School Computer Fund'. The policy also promises broadband or equivalent connections for all Australian schools. The policy document explicitly states that 'Australia must accept the fact that computer technology is no longer just a key subject to learn, it is now the key to learning in almost every subject' (ALP 2007).

Not all projects target the young. Several recent projects have focused especially on regional and remote areas, or on specific socio-economic, ethnic or age groups. edgeX.org.au focuses on the regional Queensland city of Ipswich, near Brisbane; it aims to build ICT, Web 2.0 and social networking capacities among resident groups, from school-age children to seniors (Bruns and Humphreys 2007). Such projects have the dual aim of helping participants develop functional digital literacies and building their capacities for active, productive, and socially embedded participation in the knowledge economy.

Due to its recent strong economic performance, Australia is currently experiencing a period of prolonged skills shortages across a number of areas but especially in the trades (e.g. there is a shortage of electricians and plumbers). There has also been a marked reduction in enrolments in information technology (IT) disciplines and a downsizing of IT departments at many universities and technical and further education (TAFE) colleges. Some people argue that this apparent decline in enrolments is a disguised fragmentation of the IT market, with students enrolling instead in such courses as 3D design, online gaming and culture, and interactive multimedia, rather than in traditional (IT) degrees. Multidisciplinary and hybrid offerings reflect other changes in the Australian economy and a gradual evolution of economic policy favouring the service, knowledge, and creative industries. These developments support combining IT skills with disciplinary knowledge in design, business, law, and the creative industries. Australia's continuing transition to a knowledge economy and network society is also reflected at other levels of the Australian education system. However, the industry is concerned about a future skills shortage (see 'Australia's Unhappy ICT Workforce').

OPEN SOURCE AND OPEN CONTENT

Open and reliable access to information is an increasingly important issue in Australian policy debates. State and national libraries and archives have been exploring questions surrounding open access to government information and documentary resources of national significance for several years. These have been complemented recently by projects examining and developing the relevant legal frameworks to ensure citizen access to important information (see 'Legal and Regulatory Environment' in this chapter).

It is not yet clear how far Australian governments will go with respect to a possibly broader uptake of open access and creative commons principles in their everyday operation and policy, and of open source software as an underlying technology for government services. The new government highlighted the need for citizen access to information and knowledge during its time in opposition, but such ideas have yet to be translated into concrete government policy.

Access to data and code and transparent and accountable handling of information are also seen to be linked directly with the use of open source software for processing, storing, and accessing information. This is increasingly highlighted in the area of health-related information and electronic health records (EHR). For example, Australian researchers and developers are involved in the Open Health Tools community, 'an ecosystem that brings together members from the health and IT professions to create a common health interoperability framework, exemplary tools and reference applications to support health information interoperability' and which involves the federal government organization Health Services Australia (Open Health Tools 2008). Another project is the *open*EHR project (http://www.openehr.org/) operated by University College London and Ocean Informatics Ltd. Australia, which aims to 'enabl[e] ICT to effectively support healthcare, medical research and related areas' (*open*EHR 2007). However, these projects are at a relatively early stage of conceptual and technological development, and significant take-up in everyday practical application remains to be seen.

Australia's Unhappy ICT Workforce

At the start of 2008, Ms Sheryle Moon, CEO of the Australian Information Industry Association, warned that the biggest threat to the sustainability of Australia's ICT sector is not so much the 1.52 percent of Australian carbon emissions attributable to the industry, but a pressing and increasing shortage of relevant skills: 'falling ICT student enrolments, an

increasingly competitive labour market, and the imminent retirement of the baby boomer generation' (Moon 2008). Attributing part of the problem to a brain-drain, Moon argued that sustainable organizations 'must move beyond environmental and efficiency concerns to embrace the challenge of changing workforce demographics'. With ICT workers reportedly suffering from job stress and poor management, which cause absenteeism and staff turnover (what Australians call 'churn'), Moon suggested that employers need to 'transform the nature of industry workplaces to address these problems'. Moon called upon Australia's ICT industry to develop new ideas that would align industry values with the values of the workforce and change workplaces for the better to reduce separations, encourage training and recruitment, and persuade older workers to continue in their jobs.

This is not the first time that problems with the ICT industry as a place to work have been identified. Citing Australian Bureau of Statistics data from 2005, the Australian Computer Society notes that 95 percent of businesses are small, employing fewer than 20 people, with a predominantly male workforce. Overall, 68 percent of the workforce and 79 percent of professional and technical staff is male (ACS n.d.). In the wider ICT-related industry there were 371,150 employees recorded in mid-2006, with the proportion of male workers rising to 84.5 percent (Government of Western Australia 2007, p. xvii) and those under 30 years old accounting for 27.7 percent (ACS n.d.). In addition to the gender imbalance, a recent report found that parents have a 'reticent or suspicious attitude toward the industry due to the perceived vulnerability of the sector following the "dot com" crash'. They also saw an IT career as being for '"geeks"', and as being a boring and high risk career with limited financial reward' (Government of Western Australia 2007, p. xxiii).

Given the long and generally unsuccessful attempt to recruit more female students to ICT courses in Australian universities, it will be a particularly critical issue if the industry also loses its attraction for its disproportionately young, male workforce.

(Sources: ACS n.d.; Government of Western Australia 2007; Moon 2008)

ICT RESEARCH AND DEVELOPMENT

Australian-based researchers continue to work closely with colleagues and government and non-government organizations in other Asia Pacific nations to explore the ICT for Development field. Ethnographic action research methodologies (Tacchi et al. 2003) pioneered by Australian-based researchers have been especially important in engaging with local communities in India, Nepal, Sri Lanka, Indonesia, and elsewhere, in collaboration with community multimedia centres that provide local people with ICT skills and enable them to communicate their own views and ideas.

In contrast, research within (and mainly directed at) the Australian context focuses more on the future development of advanced information and communication technology and services, and their contribution to the economy and society. The establishment of the Smart Services CRC in early 2008 builds on this agenda. The Cooperative Research Centre, an AUD 120 million project supported by the Australian Research Council and several Australian universities and industry partners, demonstrates the continuing shift in research and policy emphasis from technology to services. In particular, the Cooperative Research Centre will investigate the impact of the increase in user-led content creation, social media, and Web 2.0 practices on government, business, and other forms of service delivery.

CHALLENGES AND OPPORTUNITIES

The shift to services points to a continuing need to build advanced ICT literacies and capacities in the general Australian population, to avoid a widening of digital divides in the community and to enable all Australian citizens to participate effectively and successfully in future socially networked digital environments. Over time, these developments are also likely to be exported to other parts of the region.

It is likely that Australia's researchers and practitioners will continue to engage most closely with their nearest and

most populous neighbour, Indonesia. There have been recent improvements in what has at times been a difficult relationship. On the other hand, China looms large as a major partner in trade and intellectual exchange, especially following the Beijing Olympics and given that Australia's prime minister is a fluent speaker of Mandarin.

Beyond trade itself, a key aspect of any regional exchange has to do with Australia's role as an important exporter of tertiary education to the region. A significant percentage of students at Australian universities are international students from the Asia Pacific. Gradually the emphasis of international education is shifting from undergraduate to postgraduate qualifications. But the trade in international student education is threatened by the strong performance of the Australian dollar and the otherwise gloomy outlook for the overall world economy, which might combine to limit the ability of prospective international students to finance study at an Australian university. But this may be addressed through the increased development by Australian universities of campuses in the students' countries of origin.

Finally, the increasingly strongly felt limitations of the domestic Australian ICT infrastructure, especially the relatively poor value-for-cost ratio of the Australian consumer broadband network, may hinder further development of ICT research and practice in the country. While the new federal government made improvements to consumer broadband one of its central campaign promises, the present intractable situation in the domestic ISP market with the hostility between Telstra and its rival Optus-led consortium may cause significant delays in the realization of such promises.

NOTES

1. ZDNet.com.au carries up to date news on Australian technology issues.
2. Hyper-local journalism projects aim for news coverage at a community level, at and below the level of entire cities and towns. Such projects aim to fill a gap in coverage that is common in mainstream news media, which usually do not have the resources or inclination to cover events below international and national levels.
3. All but 20 or so of the over 200 indigenous languages are judged to be endangered.
4. Related projects, such as the UK government's e-petition site (http://petitions.pm.gov.uk/), appear to have had mixed fortunes so far (Virkar 2007).
5. The summit is an unelected body without formal influence on policy decisions.

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.bd

Bangladesh

Ananya **Raihan**

Total population	140.6 million (2001 Census, updated in 2007)
Literacy rate	47.9% (male = 54%; female = 41.4%)
GNP per capita	USD 599 (FY 2008)
Computers per 100 inhabitants	1.2 (2006)
Fixed-line telephones per 100 inhabitants	2.63 (2007)
Mobile phone subscribers per 100 inhabitants	22.91 (2007)
Internet users per 100 inhabitants	0.29 (2007)
Domain names registered under .bd	5,987 (December 2007)
Broadband subscribers per 100 inhabitants	No data available
Internet domestic bandwidth	No data available
Internet international bandwidth	24.78 Gbps (December 2007)

(Sources: Bangladesh Economic Survey 2008; BTRC 2008; ITU 2007)

INTRODUCTION

Bangladesh is classified among the world's least developed countries (LDCs). It also has the highest population density in the world: around 150 million people live in a tiny territory of 147,570 square kilometres. But in 2001–2005, Bangladesh experienced a dramatic reduction of poverty, with poverty headcount rates declining significantly in both rural and urban areas.[1] The poverty gap (depth of poverty) and squared poverty gap (severity of poverty) also declined in 2005 (BBS 2006). In short, poverty reduction is occurring at a relatively faster pace than in the past.

Nevertheless, poverty remains a problem and poverty reduction continues to be the focus of national development. Information and communication technologies (ICTs) are considered an important tool in development efforts. The poverty reduction strategy paper for 2005–2007 identifies several measures for mainstreaming ICTs in economic development. Progress has been achieved in some areas, such as in mobile telephony, but it has been slow in others.

TECHNOLOGY INFRASTRUCTURE

Robust growth characterized the telecommunications sector of Bangladesh in 2007. While mobile teledensity had been predicted to reach 10 percent by 2010 (Raihan 2007a), actual teledensity by end of 2007 stood at 22.91 percent, more than twice the target (BTRC 2008). There were 34 million mobile phone subscribers by the end of 2007. Competition policy and deregulation account for this phenomenal growth in the mobile sector.

In contrast, the fixed/PSTN market has seen modest growth — 1.19 million Public Switched Telephone Network (PSTN) subscribers at the end of 2007 from 1.01 million in June 2006 (17.82 percent) — because the major market, Dhaka city, was closed to competition until July 2007. In March 2007, the Bangladesh Telecommunications Regulatory Commission (BTRC) invited bids from private operators for four licences to operate fixed-line connections in Dhaka. The new operators started setting up connections in September 2007. With the deregulation of the coveted Dhaka city market, a 100 percent growth in the PSTN market is expected by the end of 2008. BTRC divided the country into five zones and granted 35 licences to 15 private sector PSTN operators under the open licencing system in the north-east, south-east, north-west, and south-west zones.

The fierce competition among the mobile telecom operators led to a nosedive in call rates within the domestic market. Some operators offer calls for only 0.4 cents per minute, the floor rate fixed by the regulator. Among South Asian countries, Bangladesh offers the lowest mobile phone call rates (Samarajiva and Zainudeen 2008).

As of April 2008, 85 percent of the country had mobile coverage. The government announced the penetration of the mobile phone network in the remaining three hill-districts (initially only in municipal areas) in May 2008. The licence to operate in these districts had been pending due to the insurgency problem.

In contrast to mobile service uptake, Internet adoption has been slow, mainly due to the high price of Internet connectivity. The expectation was that after Bangladesh got connected to the

information super highway via the South East Asia–Middle East–Western Europe–4 (SEA–ME–WE–4) submarine cable, the quality of Internet connectivity would improve and cost would be reduced. Indeed, data transfer capacity went up to 14.78 Gbps, 64 times higher than total capacity at the time of installation in May 2006. By June 2007 the utilization was up to 3.28 gigabytes. But the state-owned Bangladesh Telecommunications Company Limited (BTCL) fixed an exorbitantly high price for bandwidth. Thus, the Internet service providers (ISPs) have not been able to reduce the price of bandwidth for subscribers. Moreover, many ISPs have had to maintain redundancy by using very small aperture satellite-based (VSAT) connectivity due to the unreliable fibre optic connection.

In response to lobbying by various stakeholders, BTCL reduced Internet tariff charges by 20–40 percent in February 2008. Charges for monthly office use came down to about USD 10 from about USD 14.3, and the annual cost of leased Internet access up to 2 Mbps came down to about USD 20,571 from about USD 27,428. It is expected that the reduced rates would result in a net gain of USD 12.5 million as the user base would increase threefold due to the price reduction.

But industry stakeholders consider the revised rate to be still high compared to rates in neighbouring countries. For example, the reduced rate is 10 times higher than the price for the same bandwidth in India. The USD 35.1 million investment cost of the existing submarine cable has already been recovered, which is a strong argument for further reducing Internet access rates to make them at par with the rates in other countries in the region.

BTCL was allowed to own the only submarine cable network in spite of a provision in the telecom law that states:

> If an operator provides more than one service, but there exists competition in the market in providing one of such services and no competition in case of another service provided by him, then subsidy from the earnings of the service which is subject to competition shall not be allowed for the other service which is not subject to competition. (Bangladesh Telecommunications Act 2001, Section 49, Sub-section C)

Exclusive ownership of the submarine cable's landing station has extended BTCL's monopoly to data connectivity and the Internet market. This monopoly is the primary reason for sluggish growth in the use of the available bandwidth. In May 2008, the government decided to allow the private sector to install and operate a submarine cable, which is expected to reduce the price of Internet connectivity.

Responding to public demand, BTCL revised the rates for Internet services anew in the first half of 2008. For organizational users, the price is now BDT 27,000 per Mb. There is a special 75 percent discount for research organizations and primary schools will get 64 Kbps Internet connections free of charge. This can be a good opportunity for rural ICT initiatives.

On the other hand, the security of the submarine cable remains an issue. Since the installation of the cable in May 2006, connectivity has been disrupted 24 times. The Bangladesh Telegraph and Telephone Board (BTTB) has identified the cause as sabotage. The uneven competition among various players in the Internet connectivity market is probably one of the reasons for such 'sabotage'.

The demand for telecom and Internet services is expected to shoot up in the next three years with the implementation of the government's International Long Distance Telecommunication Services (ILDTS) Policy in the second half of 2008. The policy legalizes Voice over Internet Protocol (VoIP) services. Total bandwidth demand is expected to reach at least 15 Gbps in 2011, saturating the current capacity of the submarine cable. To prepare for this eventuality, BTCL has signed a deal with the Power Grid Company of Bangladesh for backup fibre-optic connectivity. There are also offers to establish redundant fibre optic lines from various private sector companies or consortiums, including Mahanagar Telephone Nigam Ltd (MTNL), VSNL, Bharti, BSNL, Reliance Communications, VSNL International, Asia America Gateway Cable, SEA–ME–WE–3, SEA–ME–WE–5, and the South Asia Subregional Economic Cooperation (SASEC).

The inadequate power supply in the country also impacts negatively on the growth of the ICT sector. Many domestic and international agencies are working to find solutions, with some focusing on alternative and cheaper power sources and others focusing on low-power ICT equipment.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The ICT Task Force was formed under the Prime Minister's Office in 1997 to foster the integration of ICTs in mainstream economic and governance activities. But the Task Force has met only three times since it was established. Mainstreaming ICT activities through the Prime Minister's Office did not work and in fact disempowered the Ministry of Science and ICT. The caretaker government recently took the initiative of revitalizing the ICT Task Force. However, the government has become preoccupied with election-related matters (with elections due to

be held in December 2008) and the initiative to accelerate ICT integration is now shelved.

On the other hand, the BTRC became more visible after its current chairman started introducing discipline in the telecom market. The role of the BTRC is to create a level playing field in the telecom market through various market-based provisions, including licencing for different kinds of connectivity and value-added services. However, its authority is limited because the various components of the telecom industry are under different ministries. For example, broadcasting is regulated by the Ministry of Information, and ICT is under a separate ministry. BTCL enjoys a monopoly over VoIP and submarine cable-based Internet connectivity, which contradicts the Telecom Act 2001. Although the BTRC is trying to impose some discipline in this area, the Ministry of Post and Telecom is creating a barrier for fear of losing revenues.

The Bangladesh Telecentre Network is a coalition of organizations that emerged in 2007 to promote the telecentre movement in Bangladesh. It has launched Mission 2011 (www.mission2011.net.bd), a movement to build a sustainable information and knowledge system for the poor and the marginalized by 2011, the 40th anniversary of Bangladesh. Bangladesh Telecentre Network's action plan articulates two objectives:

1. Building awareness among stakeholders, including the government, about the importance of building an information and knowledge system for the poor through the establishment of a network of ICT-based telecentres.
2. Supporting grassroots telecentres, and ensuring their sustainability and scalability, by strengthening their capacity to offer services.

As of October 2008, 2,012 telecentres have been established in Bangladesh. Mission 2011 has attracted the support of the government and the international community.

ICT AND ICT-RELATED INDUSTRIES

The export volume of the country's software sector declined in 2007 due to uncertainty in foreign investment and the shifting of some business to Nepal, Vietnam, and the Philippines. Software export earnings in 2007–2008 increased to USD 30 million in 2007–2008, after a slight fall in 2006–2007 (USD 26.08 million compared to USD 27.01 million in 2005–2006).

Until 2007, the sector had enjoyed steady exponential growth.[3] But the full potential of the ICT export sector has yet to be realized due to inadequate supply of skilled human resources, inadequate project management skills, inappropriate

and inadequate financing, and inadequate attention given to marketing. Another reason could be the government's lack of confidence in the sector's potential, as evidenced by the fact that the plan to build a technology park has remained unrealized for almost a decade. Moreover, not enough attention is being given to improving the quality of primary and secondary education.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

A Pentium 4 computer with 128 MB of Random Access Memory (RAM) and a full set of accessories can be purchased in Dhaka and other cities for approximately BDT 28,000 (USD 400) if it is a clone, or about BDT 55,000–70,000 (USD 750–1,000) if it is branded. This has been made possible by the zero tax policy implemented since 1998. The policy has made Bangladesh the fastest growing personal computer (PC) market in South Asia.

A more recent policy is the ILDTS Policy 2007 that came on the heels of the government drive against illegal VoIP services. Among others, the policy bars foreign telephone companies and ISPs and those owned by non-residents from obtaining licences to operate any kind of system through which overseas calls can be channelled, including the International Gateway (IG), Interconnection Exchange (ICX), and Internet Exchanges (IX). The policy also requires ILDTS operators to provide call detail records and to install monitoring facilities for voice and data calls that shall be accessible to the BTRC. The new policy makes it mandatory for all telecom operators to give law enforcement agencies access to records in the name of lawful interception, in accordance with the Bangladesh Telecommunication Act of 2001.

The hard-line stance was taken because all of the phone companies, including foreign investors and ISPs, were found to have been involved in illegal VoIP activities that were depriving the government of millions of dollars in revenue from overseas calls. The initial assessment of lost government revenue due to illegal VoIP was around USD 295 million per year, but the latest assessment puts the figure at around USD 2.2 billion a year.

In December 2007, the BTRC organized an open auction for setting up three IGs to handle IP-based phone calls using landline and cellphone systems, the submarine cable, and the overseas phone exchanges. Setting up the IGs and associated system would effectively eliminate illegal VoIP activities.

The new policy apparently favours domestic companies. But time will tell whether these companies will be able to make the large investment (about USD 135 million) required for ILDTS. The policy might have the unintended effect of encouraging the entry of more middlemen. Moreover, when the new system

adds new operators, they would charge the phone companies extra for each call, a charge that would ultimately be passed on to subscribers. Technology transfer would also be an issue as foreign companies are likely not to be interested in investing in local telecoms infrastructure development without a share of the revenue. It is likely that business consortiums will be formed to bid for the new licences.

The BTRC also intends to stop the use of VSATs by the ISPs to pave the way for a single gateway for international data exchange. This decision would reduce the scope for redundancy of the private operators vis-à-vis the BTCL. VSATs are now providing an important backup for the on-land fibre optic line linked with the submarine cable that connects Bangladesh to the information highway. When the fibre optic line between the submarine cable in Cox's Bazar and Chittagong's phone network is cut off, the VSATs provide a slower but workable backup.

The BTRC has also initiated the licensing of call centre businesses. Call centre entrepreneurs will enjoy a tax holiday for three years in Dhaka and Chittagong and five years in other parts of the country. The cost of obtaining the licence is BDT 5,000 (USD 72) for five years, with no renewal fee.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Witch-hunt for Copyright Violators

In January 2008, the Patent and Copyright Office in Dhaka issued a public notice in the daily newspapers stating the penalty for copyright violations (i.e. up to five years in jail plus fines). The move was supported by Bangladesh Association of Software and Information Services (BASIS), the national software association. However, unless awareness of copyright issues among all stakeholders, including law enforcers, is raised, it is doubtful whether this drive against copyright infringement would benefit the new economy.

In fact, the reason for the crackdown on copyright violators is unclear. The WTO Agreement on Trade Related Aspects of Intellectual Property Rights stipulates that LDCs are exempted from copyright obligations until 2013. In a country like Bangladesh, there should be a longer transition period to full enforcement of an intellectual property regime. A strict enforcement would be tantamount to blocking access to ICTs for the majority of the population and small- and medium-enterprises as the income level of these groups do not allow them to purchase proprietary software. In addition, alternatives to copyright systems, such as use of open source and open content, should be given more attention.

The Right to Information

The government enacted the Right to Information Act 2008 through an ordinance in October 2008. It was a longstanding demand of the civil society of Bangladesh, which worked closely with the government to draft the Act. Sixty-five countries have enacted Right to Information laws. In the Indian sub-continent, India passed the Right to Information Act in May 2005 and Pakistan promulgated an ordinance ensuring people's access to information in June 2002. The UN General Assembly recognizes freedom of information as a fundamental right and the touchstone of all freedoms to which the United Nations is consecrated. The right to information enables citizens to seek information from government and it requires government to proactively disseminate important information even when no demand or request for it has been made. The promulgation of a Right to Information law in Bangladesh is expected to give communities greater access to and enhance their participation in information-related activities.

The Right to Privacy

In October 2007 the Rapid Action Battalion (RAB) and BTRC ordered ISPs to provide them with a complete list of Internet subscribers and their confidential data in order to profile the country's Internet users. Names, addresses, connection and usage details, and server passwords were among the information requested. All 72 ISPs in Dhaka, Chittagong, and Sylhet were also required to install RAB 'traffic scanners' on gateway routers and give each subscriber's Multi Router Traffic Grapher URL user id and password to allow monitoring of Internet usage (Mendoza 2007). In addition, RAB and BTRC members began searching homes with high-speed Internet connections.

All these were supposedly part of the government's crackdown on VoIP operators that began in December 2006. But it is difficult to understand why 'regular home users' were included in the VoIP crackdown. Section 43 of the Bangladesh Constitution recognizes a person's right to privacy of correspondence and other means of communication. By taking extreme measures against illegal use of VoIP, BTRC has ended up violating this basic right.

Operationalizing the ICT Act

ICT entrepreneurs are expecting the ICT Act of 2006 to pave the way for the growth of e-business in Bangladesh. The ICT Act provides a framework for electronic authentication of transactions and payments, including the creation of a digital signature certification authority. The Act also includes a

provision for curbing cybercrime. However, due to lack of understanding and confidence among the relevant authorities, particularly Bangladesh Bank, the country's central bank, the Act has not been operationalized.

DIGITAL CONTENT

The launching of the Bangladesh Government (BG) Press (www. bgpress.gov.bd) in February 2008 was an important event in the history of facilitating access to government information. BG Press is the single point of publication of all gazettes and documents related to the functioning of the government and the state. Initially, the website will publish gazettes released in 2008 and 2007. An earlier digital content initiative made government forms more accessible to citizens via the Web service www. forms.gov.bd. Many people access and download the forms through telecentres for a minimal fee.

Local digital livelihood content generation by NGOs gained further momentum in 2007. A new portal, www.ruralinfobd.com, emerged in late 2007 following the path of www.jeeon.com.bd, the largest portal in the Bangla language. It was developed for telecentre operators by a private sector entity named WinBD, with financial support from a donor consortium.

The United Nations Development Programme (UNDP) has also sponsored the development of animated content in three areas: livelihood, indigenous knowledge, and conversion of content for visually impaired citizens.

The Bangladesh Telecentre Network and KATALYST, a donor consortium project for small and medium enterprise development, are working with government content generating institutions, while the Development Research Network (D.Net) has trained a group of volunteers in the rural areas for in creating local content.

The Bangladesh Open Source Network (BdOSN) has been systematically promoting the Bangla Wiki (http://bn.wikipedia. org) with a network of volunteers. The Bangladeshi media industry has also made significant progress in generating and promoting Bangla content in text and audio-visual formats. All newspapers and electronic media houses in Bangladesh have a presence on the Web.

ONLINE SERVICES

As part of efforts to ensure free and fair national elections, the caretaker government developed a new voter list that also included photographs and finger prints. This was a response to the Election Commission's finding that there were 12.2 million fake voters in the old voter list. The new voter list of some 80 million voters was prepared over 18 months by the Bangladesh Army with the support of the UNDP, using 8,000 laptop PCs. The government has also issued an all-purpose national identity (ID) card that citizens need to access many citizen services. This was the largest ICT project in the country implemented using local expertise.

In November 2006 GrameenPhone Ltd, in cooperation with Telemedicine Reference Centre Limited (TRCL), launched a health information service known as HealthLine. This is a 24-hour medical call centre through which GrameenPhone subscribers can consult with licenced physicians. Given the average of one registered physician for every 4,000 people in Bangladesh, this service could have a significant impact on primary healthcare provision in the country. Some of the services initially available under this program are:

- Information on doctor and medical facilities
- Information on drugs or pharmaceutical products and services
- Information on laboratory test reports (interpretation)
- Medical advice/consultation with a doctor (for registered subscribers)
- Help and advice during a medical emergency.

A call to the HealthLine number costs BDT 15 (USD 0.20) for the first three minutes and USD 0.065 per minute thereafter. There is also a one-time registration fee for some of the services. In addition, a subscriber can send a request by SMS to designated diagnostic centres for pathology/radiology test reports to be delivered to the subscriber's address. A short message service (SMS) request is charged BDT 10.

To start with, a database of registered doctors (8,000+), clinics, hospitals, medical facilities (850+), diagnostic centres (250+), and drugs has been created. More services, facilities, deliverables, and information will be added to the database. GrameenPhone is also aiming to offer this telemedicine service via its Community Information Centres.

The HealthLine service is based on a successful experiment by D.Net in 2004 that showed that majority of call centre queries are health-related.

Another promising mobile phone-based service is CellBazaar (see 'CellBazaar').

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

ICT education in Bangladesh is generally concentrated at the tertiary level. Although there is an optional course on computers

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CellBazaar

GrameenPhone Ltd and USA-based CellBazaar have introduced a service connecting buyers and sellers through mobile phones. The service enables sellers to list details of their products or services in a database that buyers can access through SMS. For example, a customer looking for an IBM laptop within the price range of BDT 25,000–30,000 can send the following SMS to the CellBazaar number:

> buy ibm
> laptop
> 25,000–30,000

The customer will get a reply listing available IBM laptops within that price range. The customer can then select from the list and send an SMS with the item number to 3838 to get the contact number of the person selling the laptop.

The system does not handle transactions; it simply puts buyers and sellers in contact with each other via mobile phone. But it saves buyers a lot of time and transport costs. The system also has the effect of making price information more transparent and widely available.

Bangladesh has around 34.37 million mobile phone subscribers, with five mobile service operators. Currently the CellBazaar platform can be accessed by 16.48 million mobile phone users through GrameenPhone. The system, which is a brain child of Kamal Quadir, CEO of CellBazaar, was developed at the MIT Media Lab of the Massachusetts Institute of Technology.

(Source: Rajputro 2006)

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in the secondary schools, the course curriculum is outdated and there is little opportunity for hands-on practice. Only 10 percent of schools have computer facilities and few teachers are trained and/or willing to teach computer literacy classes.

There are a number of private initiatives to extend ICT education in secondary schools. The most noteworthy is the Computer Learning Programme sponsored by the Volunteers' Association for Bangladesh New Jersey Chapter (www.vabonline/vabnj), a group of US-based Bangladeshis. The initiative, which is being implemented in collaboration with D.Net, aims to establish 1,000 school-based learning centres by 2010. To date, 100 centres have been set up. Another private sector initiative is the School Online Program of Relief International, which has set up 27 Internet learning centres. British American Tobacco's 'Disharee', which provides ICT skills training and job counselling services to the children of tobacco farmers, is also noteworthy.

The lack of local content is also a barrier to increased use of ICT in schools. To address this gap, the Institute of Education and Development at BRAC University, in collaboration with the Foundation of Education Research and Education (FERI) and D.Net, is developing interactive digital content in science and mathematics for Grades 6–10 students. BRAC University has also developed a CD-ROM for English language learning based on the national curriculum. D.Net has developed 'Computer Teaches Everyday English', an English language learning

Compact Disc-Read Only Memory (CD-ROM) for secondary school students. These materials are currently being tested.

ICT in non-formal education (NFE) in Bangladesh is more vibrant. A study commissioned by UNESCO, Bangladesh (Raihan 2007b) identified 23 organizations that are involved in developing various kinds of ICT-based learning materials for the NFE sector. The study found 195 such materials developed since 2004. Over 60 percent of the materials are video, animation, or a combination of the two. Video compact disc (VCD) is the most common format used since there is a higher degree of penetration of VCD technology in the rural areas. Over 60 percent of the materials are intended for children, students, and youth groups and 18 percent are for the disabled. There are no materials for the aged and for indigenous people.

The developer institutions identified the following constraints to educational content development: lack of a ready market, inadequate and irregular funding, lack of proper facilities for developing high-quality ICT-based materials, lack of skilled professionals, inadequate experience of educationists in ICT-based materials development, low penetration of ICT, and power supply interruptions.

NGOs generally develop materials for their own outlets. Some also supply other NGOs either for free or for a nominal charge. A few NGOs sell their products through retail chains. The Bangladesh Centre for Communication Programs (BCCP)

outsources marketing and sale of their 'Nijeke Jano' (Know Yourself) package to a commercial outfit.

D.Net and BCCP are piloting revenue models for ICT-based materials. Studies show that there is a demand for quality ICT-based materials and organizations are ready to pay for them. Although the current market size is relatively small and the number of developers is limited, there is a big opportunity in this segment of the market with approximately 150,000 groups and organizations running NFE programs. Moreover, the plan to establish 40,000 telecentres by 2011 implies a significant expansion of the potential market for ICT-based literacy and skill training materials.

OPEN SOURCE/OPEN CONTENT INITIATIVES

The open source and open content movement is gaining momentum in Bangladesh through the efforts of the Bangladesh Open Source Network (BdOSN). One of the organization's major programs is the Open Source Camp, which provides users with hands-on experience with GNU's Not Unix Linux (GNU Linux), Open Office, Mozilla, Linux, Apache, Mysql and Php/Link Access Procedure for Modems/Windows, Apache, Mysql and Php (LAMP/WAMP), and Wikipedia. BdOSN also established the Open Source Support Centre in Dhaka in 2007. The centre, which is run by volunteers and which is the first of its kind in Bangladesh, distributes compact discs (CDs), books, and other materials on open source and open content, and provides hands-on support to users.

In addition, the Bangladesh Telecentre Network and BdOSN are working together to provide software and training to grassroots telecentre operators. BdOSN is also providing training on open source technology to 740 government officials.

Bangla Wikipedia is growing rapidly with many contributions from all over the world. The total number of entries is now more than 10,000. Bangla Wiki, a wing of BdOSN, is expanding, modifying, and improving the wiki articles. They have also taken the initiative to increase the number of articles about Bangladesh in the English Wikipedia.

ICT FOR DEVELOPMENT RESEARCH AND DEVELOPMENT

In 2003 D.Net started the Pallitathya action research to determine the role, if any, of access to information and knowledge in poverty alleviation. The Pallitathya model promotes an information and knowledge system for the poor and marginalized with five components: content, multiple channels of information and knowledge exchange, an Infomediary, ownership, and mobilization. Content has been developed in nine areas: agriculture, health, education, non-farm income generating activities, awareness, employment, disaster management, directory information, and appropriate technology. This is now packaged as the Jeeon Information and Knowledge Base on the secure Web-based content management system (www.jeeon.com.bd) that is available to all telecentre-based and individual users across the country. Video and voice content is also being developed as the second generation content. 'Moni — the mobile lady' is an example of animated content on the system. Moni is a character who promotes livelihood information services door to door. D.Net has established common access points called Pallitathya Kendra in 39 remote villages of Bangladesh after the model was successfully tested in four villages.

D.Net has experimented with other modes of making information services available to rural users. One of these is 'mobile ladies', women sitting at help desks who use mobile phones to put rural users in touch with experts on various livelihood issues. Among the experts who respond to queries from villagers are lawyers, agriculture specialists, veterinary doctors, and education specialists. The mobile lady concept has been integrated with the Pallitathya Kendra, making possible a 'no refusal' and 'no exclusion' policy for accessing information and knowledge.

As part of a research and development (R&D) program, D.Net has developed the concept of Benefit on Investment which measures in monetary terms the benefits that a community receives from a telecentre. Some benefits cannot be monetized. But benefit on investment is a broader concept than return on investment (ROI) and is a better basis for determining sustainability, as it highlights the role of the community and of the government as providers of common goods (Raihan 2007a).

CONCLUSION

In general, the ICT sector of Bangladesh showed a vibrant performance in 2007–2008. There were some well considered policy moves in a number of areas that gave stakeholders hope. Mobile telephony continued its robust growth, while some signs of growth were also observed in the Internet market. Further streamlining of policies and regulation to encourage healthy competition and adequate provision of public goods, where required, is expected. Most of all, a public-private partnership in building a telecentre network across the country will make possible a dramatic improvement in public access to ICTs and ensure that e-governance services will reach marginalized communities nationwide.

NOTES

1. According to the household income and expenditure survey (HIES) of 2005, the headcount rate or incidence of poverty based on the upper poverty line was 40 percent (43.8 percent rural and 28.4 percent urban). The headcount rate based on the upper poverty line in 2000 was 48.9 percent (52.3 percent rural and 35.2 percent urban). Head-count rates based on the lower poverty line stood at 25.1 percent in 2005 (28.6 percent rural, 14.6 percent urban), and 34.3 percent in 2000 (37.9 percent rural and 19.9 percent urban).

2. There would be a 45 percent loss due to the reduction of tariffs worth about USD 4.6 million, but the price reduction is expected to lead to a threefold growth in the user base and additional income worth about USD 17.1 million.

3. Bangladesh earned USD 4.20 million from the export of software in 2002–2003, USD 7.19 million in 2003–2004, and USD 12.68 million in 2004–2005.

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.bt

Bhutan

Kuenga **Jurmi** and Sangay **Wangchuk**

Total population	646,851
GDP per capita	USD 1,414.01
Life expectancy at birth	66.25
Key economic sectors	hydropower, tourism, minerals, forest products
Fixed-lines per 100 inhabitants	4.40
Mobile phone subscribers per 100 inhabitants	38.96
Computers per 100 inhabitants	1.86
Internet domestic bandwidth	200 Mbps+ (2004)
Internet international bandwidth	78 Mbps+ (January 2008)
Internet subscribers (lease lined)	95
Dial-up Internet subscribers	12,000
Internet users per 100 inhabitants	5.9
Domain names registered under .bt	247

(Sources: Internet World Stats 2008; National Statistics Bureau 2007)

INTRODUCTION

Information Technology (IT) is a relatively new and embryonic industry in Bhutan, and its development is being informed by the Information and Communication Technology (ICT) Master Plan, which lays out three broad policy objectives: (*i*) the use of IT as an integral tool to enhance good governance; (*ii*) the development of IT and IT-enabled industries in the private sector to generate income and employment; and (*iii*) the use of IT applications to improve the livelihood of all Bhutanese.

Guiding ICT development is the Bhutan ICT Policy and Strategy (BIPS) launched in July 2004 which calls for balanced and sustainable development based on five pillars: policy, infrastructure, human capacity, content and applications, and enterprise. In June 2006, the Bhutan Information, Communication and Media Act (ICMA) was approved. One purpose of the ICMA is to encourage local and foreign investment in the ICT and media industries by providing a modern regulatory framework that fosters a convergence of information, computing, media, and communications technologies, and facilitates privatization and competition. Provisions for the protection of digital data and information privacy exist under the ICMA, including the consequences of infringement. Documentation is being drafted by the Royal Government of Bhutan (RGoB) to highlight the ICMA's relevant privacy provisions, along with those in the draft contract law, to provide a degree of confidence that data protection concerns are adequately addressed under existing and proposed legislation.

TECHNOLOGY INFRASTRUCTURE

Over the last few decades, significant progress has been made in the ICT infrastructure development and provision of related services across the country. The first telephone network in Bhutan was established in 1963. Thirty-five years later, in 1998, a fully digital national telecommunication network interconnecting all 20 *dzongkhags* (districts) and major towns was established. The main transmission backbone network consists of 155 Mbps digital microwave routes connected to the digital switching system. Lesser traffic spur routes consist of 34 Mbps and 8 Mbps microwave radios. A Digital Multiple Access Subscriber System (DRMASS) is deployed in areas with smaller requirements. Rural services have been extended using Wireless Local Loop (WLL) and very small aperture terminal (VSAT) technology. The major urban centres like Thimphu, Phuentsholing, Paro, Wangduephodrang, and Punakha are connected using optical power ground wire (OPGW). The national backbone transmission network thus comprises OPGW, digital microwave radios, VSATs, and the Thimphu Satellite Earth Station.

Bhutan Telecom Limited (BT), the incumbent operator, provides fixed-line and mobile telephony, Internet, and other value added ICT services in all 20 *dzongkhag* headquarters, some sections of the national highway, and many other parts of the country. BT's B-Mobile launched its mobile service on 11 November 2003. As of August 2008, BT's B-mobile customer base has reached to 200,000, whereas the number of BT's fixed-line customers decreased marginally to 28,520 from 29,857 (December 2007). Fixed-line and mobile teledensities are 4.40 percent and 38.96 percent (B-mobile and TashiCell), respectively. In 2008, BT commissioned the laying of an international optical fibre link extending from Phuentsholing to London via Mumbai. BT also became a member of LINX (London Internet Exchange). With the expansion of international

bandwidth, BT launched DSL-based broadband services on the 1st of March 2008 and, as of August 2008, it covers 15 *dzongkhags*.

In keeping with the market liberalization policy of the Royal Government, two Internet service providers (ISPs), DrukCom Private Enterprise and Samden Tech Pvt Ltd, were licenced in 2004 to provide VSAT-based Internet and value added services (VAS). These new ISPs have done away with the monopoly enjoyed by DrukNet of Bhutan Telecom and created a market of choice. Due to their presence in the market, the cost of Internet services such as leased lines and Web hosting has been reduced, connectivity has been enhanced, and new services such as broadband introduced.

A second mobile operator, Tashi InfoComm Ltd (TICL), was awarded a licence in 2006 through an open bidding licencing process. TICL launched its services commercially in April 2008. At present, TICL's mobile services are available only in six *dzongkhags*, covering 60 percent of the total population. The remaining *dzongkhags* shall be covered in the next three years as mandated by the cellular licence issued by the Royal Government of Bhutan. As of August 2008, TICL had a subscriber base of 52,000. This substantial growth from 25,000 users (end of May 2008) was achieved due to the provision of two months of free calls and SMS within the TashiCell network. TICL expects the number of subscribers to grow as the company extends its reach to other *dzongkhags* and as it continues to improve its service offerings.

The immediate impact of the entrance of a second cellular service provider is choice of cellular service and the availability of different services such as General Packet Radio Service (GPRS), Enhanced Data Rate for GSM Evolution (EDGE), third generation mobile phone standards and technology (3G), and various value added services, as well as cheaper call rates even to other countries.

Indeed, things are moving rapidly in mobile technology, with the subscriber base reaching almost 252,000, or 38.96 percent of the population, since its introduction in 2003. But the rate of Internet and computer usage in the country is low, with only between 10,000 and 12,000 computers in the country. Most of these computers are owned by the government and corporations in the urban areas. Internet use is not increasing at a rapid enough pace because of the cost factor, as well the lack of local content.

The Bhutan Broadcasting Service, the only television station in the country, is also implementing infrastructure projects, such as the construction of the National TV Centre in Thimphu, the installation of a 100 kW shortwave transmitter, and the acquisition of a control and monitoring system for its TV network.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The Ministry of Information and Communication (MoIC) was established in July 2003 as the lead government agency for the formulation and implementation of policies and the drafting of ICT legislation in the country. The MoIC is also mandated to: *(i)* develop an efficient and reliable information and communication systems to help transform Bhutan into an information society; *(ii)* promote ICT in the country as an enabler of national development; and *(iii)* develop a safe and progressive national transport system.

In order for the MoIC to carry out its mandate, the Department of Information Technology (DIT) was established as the lead department for the development, promotion, and coordination of all ICT-related activities in the country. The department has three divisions. The application division researches and recommends appropriate software applications and operating systems for adoption and use, and drafts guidelines for the development of software applications and quality control. The division also encourages, facilitates, and coordinates the creation of e-services. The infrastructure division assists the department mainly in planning infrastructure development, carrying out research on networking and hardware components, and preparing technical specifications for hardware. The infrastructure division also provides assistance to the Bhutan InfoComm and Media Authority (BICMA) in the analysis of technical matters, including interconnections, radio frequencies, and use of technical standards. The policy and planning division undertakes systematic research on laws; organizes information sessions on policy and regulatory matters relating to ICT; promotes and develops ICT services for the promotion and preservation of culture, tradition, and social cohesion; and conducts studies on the ICT sector to identify opportunities, constraints, and difficulties and to propose government intervention where needed.

Another major institution dealing with ICTs is BICMA, which was established in 2005 as the Bhutan Communications Authority (BCA). With the enactment of the Bhutan Information Communications and Media Act in 2006, BICMA was formally de-linked from its parent ministry, the MoIC. The now independent Authority's functions include regulation of telecommunications services, media services like cable television, broadcasting, and printing presses; assignment of radio communication frequencies; and management of the radiofrequency spectrum. It also licences all ICT and media facility providers and service providers, prepares various guidelines, sets technical standards, and frames terms and conditions for the provision of such services.

Besides the above-mentioned key ICT institutions, the ICT divisions and units at the different ministries, corporations, NGOs, and tertiary and private ICT training institutes assist in the overall promotion, implementation, and development of ICT policies. They also collaborate with the MoIC in the coordination of ICT activities across the country.

ICT AND ICT-RELATED INDUSTRIES

There are about 45 ICT firms in Bhutan. With the government policy of outsourcing most of its ICT developmental activities, the lifting of import duties for ICT products, and the introduction of tax holidays, these ICT businesses have grown in size, expanding their services and providing both software development and network solutions.

A medical transcript centre and a call centre were licenced in October 2006, and both have been operational since the end of 2007. The medical transcript centre has 75 agents while the call centre has 175 agents engaged in non-voice services. The latter's intended business (voice) has not taken off, largely because of the substantial investment required and the unpredictable market. Neither of the two centres is generating significant revenues, and both are in fact still struggling to meet their operational cost. However, both are absorbing many job seekers and it is anticipated that once they are fully functional, they will be able to absorb more. The two companies are being carefully watched and their success is expected to encourage the entry of new players into the market, generating revenues and more jobs for graduates as well as school dropouts.

To boost ICT development, the establishment of the Bhutan IT Park has been proposed under the Private Sector Development Project with funding support from the World Bank. The project aims to provide employment opportunities through the promotion of enterprise development in the IT and IT-enabled services (ITES) sector, enhance IT skills, and improve access to finance. The project involves a five-year investment of USD 8 million (from 2008 to 2013) for the development of infrastructure, lease-in space for an incubation facility, a shared technology centre and a data centre, an IT skills development program, and IT-related hardware and software investment in the financial sector complemented by a small amount of technical assistance advisory services.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

The Bhutan ICT Policies and Strategies (BIPS) launched in July 2004 is the main document guiding national ICT developments.

The development of BIPS involved stakeholders from the government, non-government, and private sectors. Five committees were formed along the lines of the Digital Opportunity Initiative, covering policy, infrastructure, human capacity, content and applications, and enterprise. With inputs from open consultative workshops and previous ICT studies, the committees formulated strategies and activities designed to promote ICT development in Bhutan.

The three overall policy objectives underpinning BIPS initiatives are: (i) use ICT for good governance; (ii) create a Bhutanese info-culture; and (iii) create a 'high-tech habitat'. Under each objective are five strategies as follows:

- *Policy* activities are focused on making governance more efficient, transparent and inclusive; introducing and strengthening a modern legal and regulatory framework; and investigating ways to fund ICT and reduce the costs of ICT services.
- *Infrastructure* activities are focused on implementing a liberalized and competitive market infrastructure and ensuring affordable, fast, secure, sustainable, and appropriate ICT infrastructure throughout Bhutan.
- *Human capacity* activities include developing appropriate ICT awareness and skills, from basic computer literacy to high-level technical skills, to boost the ICT industry. The aim is to improve the quality and coverage of training institutions, develop a centre of excellence, and accredit ICT training institutes in Bhutan.
- *Content and applications* targets include establishing the framework for e-business, using ICT to preserve Bhutan's cultural heritage (see 'Digital Content'), enhancing the quality and accessibility of health and education, broadening national media and Web presence, and supporting good governance.
- *Enterprise* activities aim to boost the competence of the local ICT (private) sector, and provide business opportunities by outsourcing government ICT work. Access to finance will be addressed, as well as a strategy to target export of ICT services and boost the application of ICT in non-ICT businesses.

The following are some of the programs being implemented under the five strategies:

1. Use of ICT to make governance more efficient, transparent, and inclusive, in particular through information sharing between agencies, policies on ICT security and ICT units in each *dzongkhag*, use of free and open source software, introducing the 'e-Gazette' as an official government publication

of record, and using ICT to deliver 75 percent of all public services.

2. Establishment of an ICT 'centre for excellence' to build linkages with international institutions, carry out ICT research and development, and create a standardized curriculum to develop skills required in the job market.

3. Establishment of a liberalized and competitive ICT infrastructure market by providing a licence for new operators and service providers, establishing incentives for new ICT players to set up ICT businesses, and promoting foreign direct investment in the ICT infrastructure development.

4. Ensuring that all students who have completed a basic level of education have acquired basic IT and computer skills by building the necessary infrastructure in all middle and high schools, recruiting ICT-literate teachers, training teachers in ICT use, and developing a standardized basic ICT literacy curriculum in schools and training centres.

5. Harnessing ICTs to enhance the quality and accessibility of health services by establishing links with neighbouring countries and international agencies to track emerging health threats, provide real-time telemedicine from basic health units (BHUs) to districts to referral hospitals, and set up an integrated health management system.

6. Outsourcing appropriate government ICT work by conducting a baseline survey of current ICT outsourcing practice, and developing awareness and capacity to outsource through business fairs and workshops on ICT outsourcing for industry and the Royal Government of Bhutan.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The Technical Guidelines on ICT in the 10th Five Year Plan sets out the necessary framework for mainstreaming ICT as a tool in sectoral development programs (at the central and local levels), addressing the needs of the poor, and fostering pro-poor innovation and growth through the effective and innovative use of ICT. This framework was developed as a means to achieve core development objectives embodied in the UN Millennium Development Goals and Bhutan's development concept of Gross National Happiness (GNH).

The Bhutan Information, Communications, and Media Act provides the legal basis for the regulation of the ICT and media sector. The Act is a modern technology-neutral and service sector-neutral regulatory mechanism based on the principle of convergence of information, computing, media, communications technologies, and facilities for the provision of a whole range of new ICT and media services. It provides the rationale for the creation of a new regulatory authority, BICMA (see 'Key ICT Organizations'), and its functions. It also has provisions related to ICT facilities and ICT services, the licencing mechanism for such services, and the management of the radio frequency spectrum, as well as provisions for the licensing and regulation of media content. Provisions related to cyber issues are included, such as those on electronic governance, electronic commerce,

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Bhutan's Digital Signature Project 2006

Although Bhutan is making considerable progress in implementing numerous ICT activities, the country is not able to deploy secure online applications due to the lack of a digital signature authentication framework. Thus, the Department of Information Technology (DIT), with technical and funding support from the International Telecommunication Union (ITU) and the United Nations Development Programme (UNDP), initiated the Digital Signature Project in 2006. It aims to enable the government, citizens, and businesses to communicate securely and exchange sensitive business information safely.

The project is currently in the pilot phase of deployment after the setting up of the Certification Authority (CA) and Registration Authority (RA) servers and the physical security system. The Certificate Policy (CP) and Certification Practice Statement (CPS), which are required to make a digital signature legally binding, have also been formulated with the assistance of the ITU. eTokens (smart card) containing a user's certificates and private key are distributed to users at the DIT. Basically a digital signature is used for document and mail signing and encrypting.

The next step is to deploy the technology at the ministry level and then to other agencies of the government. The deployment of completed digital signatures will happen during the 10th Five Year Plan (i.e. from July 2008 until June 2013).

(Source: DIT 2006)

and digital signatures; consumer protection in e-commerce; online privacy; domain names; operations and liabilities of ISPs; and cyber offences.

A code of content is being drawn up by BICMA to apply to all content made available by the ICT and media industry within the Kingdom of Bhutan. The code seeks to foster a sense of responsibility among content providers and to ensure that online content is safe, secure, informative, educational, and entertaining. The objective is to create a self-regulatory environment for industry to provide online content in a practical and commercially feasible manner and promote the growth and development of online service industries.

The Bhutan ICT Human Resources Development Master Plan and Strategies (BIHMPS), which is still at the draft stage, is underpinned by a vision of Bhutan becoming a knowledge-based society and is closely aligned with key strategy documents such as the BIPS and the Good Governance Report. Intended to be relevant for a period of five years, the Master Plan has been developed in consultation with various stakeholders.

Details about the laws and regulations described in this section are available at www.moic.gov.bt. The Royal Government of Bhutan is preparing other guidelines and regulations for electronic signatures, e-business, security policies, and information management.

DIGITAL CONTENT

BIPS lists under the 'content and applications' initiatives the development of 'a digital archive of significant Bhutanese re-ligious texts and cultural contents in sound and picture format'. Thus, in 1997, the DIT, with technical support from the University of Virginia and funding support from the Royal Government of Bhutan, started the National Digital Library Project. The project aims to consolidate efforts by Bhutanese individuals and communities to represent their traditions and perspectives, collect existing cultural materials, and document aspects of Bhutanese life and traditions for people to access from anywhere in Bhutan and the world. In other words, the project seeks to put together an invaluable record of Bhutanese culture for Bhutanese researchers, tourists, and anyone interested in learning more about Bhutanese culture.

During the first phase of the project (completed in July 2007), a basic portal for the digital library was built to collect the work of various agencies, with the help of consultants from the University of Virginia who had earlier worked on the Tibetan and Himalayan Digital Library (THDL). The portal includes audio files, videos, images, and texts. The project utilized Dzongkha–Dzongkha (national language), English–Dzongkha,

and Dzongkha–English dictionaries from the Dzongkha Development Commission (DDC). Thus, the content can be accessed both in Dzongkha and English (bilingual).

For the digital library to be easily accessible in other parts of the world, the project has set up a mirror server at the University of Virginia.

The next step is to put in place a public awareness component as many Bhutanese do not yet know about the project to digitize Bhutanese cultural and religious content, as well as to seek funding from donor agencies to develop the digital library further.

ONLINE SERVICES

BIPS specifies the need to introduce online services covering clearances, approvals and financial transactions, and to deploy ICT to improve the reach and quality of essential services such as education, health, and agriculture. All of the concerned agencies have put in considerable effort to provide online services since BIPS was launched. Setting an example, the DIT itself has developed and is hosting the Bhutan portal www.bhutan.gov.bt.

The portal received a boost with the completion of the Thimphu WAN connecting 42 of 72 listed organizations. The Thimphu WAN allows these organizations to access each other's websites and other online resources at very high speed. Thus, the Thimphu WAN makes it possible to exploit the opportunities for interconnection and integration of government services. However, the Thimphu WAN is at present available only in the capital. There are plans for the laying of fibre optic connections in all *dzongkhag* and *geog* (blocks or sub-districts).

Bhutan Post is implementing an electronic mail service called e-Post at selected post offices to bridge the gap between the electronic haves and have-nots. The service was launched in 2005 and has two models — the 'post office to post office' model and the 'anywhere to post office' model. The first model, which is based the originator-pays-fee model, suits those who use the post office to send their mail and who do not have access to or are not even familiar with the Internet. Such customers go to any of the selected post offices with e-Post facilities with handwritten mail, photos, floppy discs, or just a message in their mind for translation into a meaningful message to the recipient. The postmaster helps each customer send his e-Post to another post office in Bhutan. The receiving postmaster prints the e-Post, puts it in an envelope, and delivers it to the addressee. The second model, which is based on a receiver-pays-fee model, suits customers with Internet facilities. In this instance the customer sends to a post office an email containing his/her message for his/her intended recipient. The receiving postmaster prints the

mail, puts it in an envelope, and delivers it to the recipient for an e-Post fee. In the correct delivery address is not available, a telephone number may be provided and the postmaster will call the number and request the recipient to pick up his/her e-Post.

Bhutan Post is also in the process of implementing an *Easy pay and online tracking system* for both postal and non-postal deliveries. The easy pay facility will enable citizens to pay for different services at one stop. The online tracking system will enable individuals to track their mail by entering a unique barcode number.

LabourNet is an online system through which an individual, firm, company, or enterprise can forward job applications from foreign workers (expatriates, volunteers, labourers, etc.) to the Labour Recruitment Committee (LRC) for processing and approval. The decision of the LRC is uploaded to the system, and the information is forwarded to concerned applicants via email or through phone or fax. The main objective is to maintain a complete and accurate database of foreign workers in Bhutan.

Drukair, the national airline, has introduced a Web-based reservation system called *Air Kiosk* to enable customers to make reservations online and thus reduce reservation costs. The main goal is to do away with paper tickets and replace these with electronic tickets.

Other useful applications have been identified and are being implemented, such as the online issuance of security clearance, the agriculture marketing system to provide market rates and information, and online forest clearance and land transactions. In addition, 90 percent of all government forms can now be downloaded from the Bhutan portal.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

Strengthening educational institutions and curricula to provide ICT skills at all levels — from technical, professional, and entre-preneurial skills for industry and government, to basic ICT literacy for all — is one of the vision statements of BIPS.

At present, around 50–80 percent of qualified ICT personnel added to the system annually are graduates of Sherubtse College, the only institute providing degree level ICT courses, and the Royal Institute of Management (RIM), which offers diploma (DIMS) level courses. Most of these graduates are employed by the public sector with a few opting to work for private enterprises.

The BIPS report (July 2004) acknowledges Bhutan's limited capacity in building a critical mass of ICT professionals and its reliance on outside technical assistance. It also notes that there are less than 400 ICT professionals in the whole country.

This lack of Bhutanese ICT personnel is somewhat offset by Bhutan's access to a large number of ICT professionals from the region.

The availability of ICT professionals is directly linked to the output of the tertiary ICT educational institutions. There are few local training institutes and the certification they provide is recognized only within the country. As noted earlier, the two government institutes offering full-time ICT training are Sherubtse College (degree courses) and the Royal Institute of Management (diploma and Cisco programs). The Paro College of Education offers a three-year elective IT course for students taking up a bachelor's degree in Education. Some students pursue tertiary education abroad and return to Bhutan to work.

The Ministry of Education in collaboration with EduPlanner Pte Ltd, a consultancy firm from Singapore, has reviewed and revised the IT curriculum for classes 9 to 12 based on a preliminary study carried out in January 2003. The new IT curriculum, which covers learning computing productivity tools (i.e. computer applications) and programming skills, aims to enable Bhutan's young people to function effectively in the new and fast changing environment. The new IT curriculum for classes 9 to 10 was rolled out in March 2003 and by the end of 2003 eight schools had successfully implemented it as elective subjects. By 2005, 22 more schools had been introduced to the curriculum. The IT curriculum for classes 11 and 12 was rolled out in March 2005 but could not be successfully implemented due to the lack of computers in schools and the lack of qualified teachers.

OPEN SOURCE/OPEN CONTENT INITIATIVES

Dzongkha Linux, an operating system for Dzongkha Desktop using an open source platform, was developed in June 2006 to be adopted as standard operating software for government offices. However, Dzongkha Linux was not very user-friendly and there were incompatibility issues. This led to the development of an updated version called the Dzongkha Debian Linux. Launched in August 2007, the new version supports computing in Dzongkha with standard applications like word processing, spreadsheets, PowerPoint presentations, Web browsing, and chatting. The number of users remains small however, as government employees are accustomed to Microsoft packages.

To promote the use of the Dzongkha Desktop, the DIT started an awareness program and user training. The DIT also distributed customized keyboards, which means that people no longer have to type two or more letters for a single Dzongkha alphabet as they would have to when using the international standard keyboard. The Dzongkha Desktop is a good alternative

for users who cannot read and write in English because it has an interface in Dzongkha as well as in English. It can also be downloaded for free.

ICT RESEARCH AND DEVELOPMENT

Dzongkha Linux, which was funded under the PAN Localization Project, was a success story in the research and development (R&D) front. Through this project, many technical terms that did not exist in Dzongkha were translated. In order to have a complete Dzongkha computing environment, more than 90,000 terms were translated.

The second phase of the project, which started in June 2007 and is expected to be completed by 2010, aims to carry out research and develop internationalized domain names in Dzongkha, Dzongkha part of speech, Dzongkha corpus, and text-to-speech system and optical character recognition.

The last release of Dzongkha Linux came with Gnome 2.14 and OpenOffice.org.2.

CHALLENGES AND OPPORTUNITIES

The past two to three years have been spent on building the ICT infrastructure and developing policies toward further development of the ICT sector in Bhutan. Within the next five years, the aim is to establish IT parks as well as community information centres in all 202 *geogs*, set up e-governance applications, form ICT units with Bhutanese ICT personnel in all of the ministries, train more teachers, and implement a national broadband network. Internet rates are also to be reduced within the next year or so.

But for all of these to happen, a lot of resources, political will, and commitment and support from all agencies are needed. In particular, financing ICT development is a challenge. The total budget to develop ICT during the 9th Five Year Plan (fiscal year July 2007–June 2008) was BTN 80 million (USD 2 million), which is equivalent to the cost of building one higher secondary school with boarding facilities. For the 10th Five Year Plan (fiscal year July 2008–June 2009), the budget has been increased to BTN 2 billion (USD 50 million), which indicates government recognition of the importance of and opportunities available for ICT development. However, overall financing for ICT remains a major challenge for the country.

Another key challenge is coordinating ICT initiatives in Bhutan. At present, various projects seeking to contribute to the overall development of Bhutan are being carried out. However, the lack of coordination results in inefficient use of budgetary, human, and technical resources. Furthermore, most of the ICT projects are resource-driven rather than needs-driven. More importance is given to hardware than to software, training and communications. These issues should be addressed by the national policy on ICT (BIPS) and by legislation such as the Bhutan Information, Communications and Media Act. In addition, the DIT's role as a coordinator and promoter of ICT implementation is being strengthened.

To reduce the digital divide, the *dzongkhag* administration must be given priority in ICT training and deployment of ICT resources. National and agency-wide ICT master plans with achievable milestones should be drawn up. The lack of trained personnel is a big problem, leaving many organizations, including government ministries, without a long-term plan for e-services. Thus, the schools need to implement computer education and training programs. Moreover, in-country ICT firms should be utilized as much as possible so that the government and private sector can work together as a combined national resource.

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Brunei Darussalam

Yong Chee Tuan

Population	390,000
GDP	USD 12,945 million (USD 1 = BND 1.53)
Key economic sectors	Oil and gas
Computers per 100 inhabitants	20
Fixed-line telephones per 100 inhabitants	20.4
Mobile phone subscribers per 100 inhabitants	114
Internet users per 100 inhabitants	51.16
Domain names registered under .bn	No data
Broadband subscribers per 100 inhabitants	3.18
Internet domestic bandwidth	512 Kbps
Internet international bandwidth	633 Mbps

(Sources: Authority for Info-communications Technology Industry of Brunei Darussalam 2008; Department of Economic Planning and Development 2008a)

OVERVIEW

A population of less than half-a-million living in an area of 5,765 square kilometres makes Brunei Darussalam one of the least densely populated nations in the Asia Pacific region. The 2006 Gross Domestic Product (GDP) per capita was BND 47,987 (USD 33,094: USD1 = BND 1.45). More than 54.3 percent of the population is between 20 and 54 years old, which contributes to a high workforce participation rate of 71 percent. However, despite the high standard of living (high GDP per capita, low inflation and poverty rate) enjoyed by the people of Brunei Darussalam, the current unemployment rate stands at 4 percent and it is growing faster than the population growth rate of 3.5 percent which in turn is growing faster than the GDP.

Its stable socio-economic situation and geo-political position have allowed the country to effectively play a prominent role in the Southeast Asian, Asia Pacific, and other regional communities. Since becoming fully independent in 1984,[1] Brunei Darussalam has maintained a strong relationship with the United Kingdom and it is one of the pivotal links between the European Union (EU) and Association of Southeast Asian Nations (ASEAN), and among the Commonwealth states. An active member country of the Organisation of Islamic Conference (OIC), it is expanding its networking relationships with all of the Islamic countries, particularly in the Middle East. The historical trade relationship with China, which dates back to 1417 with the arrival of Admiral Cheng Ho, also remains strong.

Diversifying the oil- and gas-dependent economy and ensuring a sustainable high standard of living are the main foci of the nation's long-term development plan defined as Wawasan Brunei 2035. The aims are to transform Brunei Darussalam by

2035 into a nation widely recognized for the accomplishments of its educated and highly skilled people as measured by the highest international standards, a standard of living that would put the counry among the top 10 nations in the world, and a dynamic and a sustainable economy with a per capita income ranking among the top 10 countries in the world.

The government will focus on integrating e-government programs to enable the provision of high quality online customer services, enhancing local small and medium enterprises (SMEs) through e-business, and building human and institutional capacity in ICT applications. This amounts to an allocation of BND 1,145.7 million (USD 790 million), or 12.1 percent of the total budget, for ICT development under the National Development Plan (NDP) 2007–2012.

Prior to this injection of funding for ICT, the 8th National Development Plan 2001–2006 pushed for the introduction of an e-government program with a budget of BND 850 million (USD 586 million). This first wave of e-government development was basically more about enhancing information technology and information services (IT/IS) in government agencies than enabling online transactions. During this first wave the Prime Minister's Office (PMO) successfully rolled out a unified email system based on Lotus Notes with a suite of collaboration features to all its agencies and departments. However, due to the decentralization of e-government planning and implementation, other ministries and government agencies have adopted their preferred common office environment platforms, email systems, and information systems. The Ministry of Finance and Ministry of Education adopted Microsoft Exchange while the Universiti

Brunei Darussalam (UBD) continued to upgrade its Sun Mail, leaving other ministries to decide whether they would ride on the PMO's system. Similarly, different ministries use portal and content management systems that have different architecture and operating platforms. Besides a number of technical uncertainties, the lack of harmonization of policies and standards is one of the growing concerns about the future integration of applications and services in the country.

Despite the strong emphasis on building ICT capacity in government agencies, a detailed blueprint or roadmap for ICT development is not yet being defined. ICT players are making headway in marketing their new solutions, setting up local offices, and recruiting foreign IT professionals to begin providing specialist courses. Many of the local vendors are securing partnerships, distributorships, and/or arrangements with overseas counterparts before marketing these products/services to government agencies, academic institutions, and several private sector organizations.

Government spending on ICT devices and accessories is increasing. This is indicated by the frequency and magnitude of government invitations to tender quotations for ICT-related items. Major items are normally bundled into e-government projects. Many of these second phase e-government projects will be issued for tender only by the end of 2009.

ICT usage in multinational companies (MNCs) and SMEs is not very encouraging. Many MNCs tend to adopt international products and services instead of acquiring the services of local vendors. The adoption of ICT in SMEs, on the other hand, is mainly limited to email systems and productivity applications. In contrast, household and individual spending on ICT devices, including notebooks and mobile telephones, is expanding rapidly as illustrated by the growing number of personal computer (PC) consumer fairs and exhibitions held annually. Household spending on cars, mobile phones, consumer electronic goods, and ICT devices (in order of preference) does not appear to be affected by the marginal increase in food prices. Note that the petrol price remains constant as it is being heavily subsidized by the government. In addition, there are other benefits enjoyed by citizens and residents, such as no personal income tax and zero import tax on computers.

TECHNOLOGY INFRASTRUCTURE

Worldwide Interoperability for Microwave Access (WiMAX) zones called wave@Brunei were recently installed in Bandar Seri Begawan, the capital. But they have received a lukewarm reception from the growing number of Internet users in the country. These WiFi zones which provide prepaid broadband

Internet services are available mostly in shopping centres, student hostels, and commercial and residential areas. But the cost of BND 5 (USD 3.5) per 83 minutes seems like a high premium to pay for broadband Internet access, which many restaurants are providing their patrons free of charge. The rate appears to be more suitable for hotel guests rather than students. Connecting to the Internet at many traditional and modern restaurants while enjoying the restaurant fare, is a growing trend among young people.

The consumer sale of notebooks has exceeded the consumer sale of desktops by at least 5:1 as reported by Concept, one of the largest PC vendors in the country. The popular screen sizes of notebooks are between 12 and 14 inches while the slow-moving items are the larger screen sizes, which could be an indication of the relative mobility of the notebook-using population.

Domestic Internet subscriptions are mostly for the ADSL system called e-Speed offered by TelBru. The subscription rate of BND 68 (USD 47) per month for a 512 Kbps Internet connection is one of the most expensive ADSL subscriptions in the region. Large organizations such as the Brunei Shell Petroleum Sdn Bhd, Royal Brunei Airlines, and the Hong Kong and Shanghai Banking Corporation (HSBC) have joint leased lines from the two Internet service providers (ISPs), namely, TelBru and DST Sdn Bhd. These are state-owned corporations, which means that free market competition is unlikely to happen between the two. There is little incentive for them to engage in a price war and no pressure to lower prices from the Authority for Info-communications Technology Industry (AiTi), the regulator.

In April 2008, b-Mobile (a joint venture between TelBru and QAF Sdn Bhd) launched a 3.5G Internet service branded as ZOOM! This broadband connection using W-CDMA technology has download speeds that can reach up to 3.6 Mbps. The promotion rate is USD 55 for unlimited local usage. Similarly, in May 2008, DST Sdn Bhd launched its 3.5G Internet service called Go! Broadband carrying a maximum speed of 7.2 Mbps.

In 2006, work commenced on establishing the EG-Bandwidth, a private network linking all government agencies to their respective data centres and to the central data centre called the EG Centre. However, despite the availability of funding and pressure from government agencies, the network has remained unfinished. One convenient reason for the delay was the change in the consolidation of ministerial data centres that were deemed 'overdesigned'. However, strictly speaking, the underlying reasons for the delay in the implementation of e-government-related projects are insufficient institutional capacity, lack of skilled project coordinators, and variations in the appreciation and understanding of e-government project requirements and outcomes.

Decision-making on changes in business processes or workflow is weakened by failure to empower project managers who

are often considered to be responsible merely for technical installation of the information systems. Delay begins even at the planning stage where there are difficulties in capturing user requirements and translating them into tender documents. During implementation, confirmation of requirements, adjustment of technical variations, and getting users to sign off on deliverables are unusually time-consuming and not at par with international best practice.

In contrast, the telecommunication industry is more active and updated. In 2006, the number of mobile subscribers was 74 percent of the population. This was a remarkable increase from the 34 percent penetration rate at the end of 2001. As of March 2007, according to the AiTi, the mobile telephone penetration rate had reached 114 percent. The two operators are the same as the ISPs, with DST providing GSM services to more than 80 percent of the market and TelBru offering third generation (3G) mobile network services.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The recent restructuring of the e-government initiative has shifted the secretariat role from the Department of IT and State Store (ITSSD) of the Ministry of Finance (MoF) to a newly formed unit called the e-Government Agency under the PMO. The AiTi plays the role of e-Government Technical Advisory Body (EGTAB). The traditionally heavy involvement of the ITSSD in the centralized procurement of IT-related products and e-government development has begun to change to reflect the strategic directions of the MoF. The ITSSD's role is now reduced to that of State Store and meeting the MoF's IT needs.

In addition to the role of the government chief information officer (CIO), the permanent secretary of the PMO acts as the joint secretary of the e-Government Leadership Forum (EGTL) chaired by the PMO Deputy Minister. This structural adjustment helps to facilitate the government's business process reengineering — that is, the establishment and endorsement of e-government related policies can now be streamlined and managed at a higher level. The downside is the awkward relationship between the PMO and the AiTi, which reports directly to the Minister of Communications except in the coordination of the EGTAB.

Increasingly, the EGTAB is being tasked to look into a number of new and existing e-government issues, including institutional capacity-building, IT human resource development, and approaches to project implementation. The body has brought in expertise from the private sector and overseas agencies to cope with its rapidly growing functions and roles.

The AiTi is also tasked with the promotion of the country's ICT industry. It is currently engaged in a number of research and consultancy projects with the aim of improving ICT development among local SMEs.

Meanwhile, the chair of the Brunei IT Council remains the Minister of Communications who oversees the national development of IT. In 2007, the Ministry of Communications formulated a new strategic vision: 'towards a sophisticated society and excellence in communications'. The vision emphasizes the importance of information technologies and the capacity to effectively utilize and develop IT in the new economy. The Ministry has also pledged to introduce measures for the development of the ICT industry and the enhancement of local SMEs. The Ministry manages the National ICT Award competitions, and provides funds to winners to participate in the Asia Pacific ICT Award (APICTA) competitions held annually in rotation in Asia Pacific participating countries.

The Infocom Federation of Brunei was officially formed in 2007 to act as the platform for IT vendors to collaborate and interact, and to provide a single voice on relevant ICT issues. Another new organization in the ICT industry is the Brunei Economic Development Board (BEDB), which is the de facto focal point for attracting foreign direct investment and championing economic diversification projects such as the Methanol Plans and Pulau Muara Project. The BEDB currently manages the IT incubation centre called i-Centre, the first of its kind in the country. To date, the BEDB has attracted more than a dozen local 'incubatees' to rent office space at the i-Centre.

Last but not least, the Ministry of Education (MoE) plays an important role in the development of the ICT industry. It has the largest consumption of IT among all of the government ministries. In late 2007, the MoE launched a new 21st century education system to reflect changes in modern education, including integration of ICT in the curriculum. The e-education initiative that was started in 2002 under the 8th National Development Plan will be expanded to provide more ICT resources, digital content, and training for teachers to ensure greater adoption of ICT.

ICT AND ICT-RELATED INDUSTRIES

Since the deployment of the e-government initiative in 2001, the ICT industry has been expanded vertically and horizontally. There are two major groups of ICT vendors in the country: one group focuses on the sale of hardware, accessories, and software packages to the general public and private sector organizations, and the other group focuses on e-government projects. The second group consists of companies who see themselves as being more like system integrators, bundling solutions from overseas partners and consolidating them to suit local use. Many of these

local integrators are involved in front-runner project management services and 'project funding'.

Generally, the ICT sector contribution to GDP is less than 2 percent. The current statistics system combines 'transport' and 'communication' under one category and the major items under the category are transport-related activities. The private sector's contribution to the ICT industry is mainly in finance/banking and engineering. The country's banks are actively updating their infrastructure and services to compete with HSBC, the head of the pack, for the provision of online services. The construction industry, which contributes around 7 percent of GDP, also plays an important role in the use of ICT, as most architects, consultants, designers, and contractors are using modern ICT applications to assist their operations.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

In 2007, the Public Works Department of the Ministry of Development successfully implemented an Integrated Document Production System (IDPS) in all of its design offices to provide architects, engineers, and quantity surveyors with a common platform called the REVIT (a suite of AutoCad products). The system enables all digital drawings and documents to be shared, managed, and stored in a central server. These design drawings and tender document are then released through an online tender collection and submission module, and the contractors can collect and submit the tender documents online. In effect, this e-government project does not only transform internal operations but also pushes the private sector (consultant and contractor communities) to actively use modern ICT applications.

In another key initiative, all schools are being connected with at least a 512 Kbps leased line Internet connectivity. The connectivity will become fully operational by September 2009. In addition, every primary school is equipped with a computer lab that can house more than 25 desktop computers. The main aim of building a strong ICT infrastructure in schools is to meet the needs of the new National Education System for the 21st century (SPN21), which seeks to develop in students the skills and mindsets relevant to the knowledge economy. Communications and digital literacy skills are considered as the main components of the new skills. Parallel to the establishment of ICT infrastructure, the MoE has also rolled out a digital library system providing a single portal to access a number of electronic educational resources. The digitization of local content, such as reports, exam papers, theses, manuscripts, cultural content, and books, is carried out continuously as the information becomes available. Digital content can now be easily accessed, archived, and managed using modern technologies. Slowly but surely the teaching and learning communities will adopt and make advances in the new digital approaches to learning.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Brunei Darussalam has a stable, fair, and just legal system that is conducive to ICT development. The legal system is based on English common law with an independent judiciary, a body of written common law judgements and statutes, and legislation enacted by the Sultan and Yang Di-Pertuan of Brunei Darussalam. The Attorney-General's Chamber has assigned a team of dedicated lawyers to assist in developing and vetting e-government contracts. They have adopted several best practices in IT implementation and are replacing clauses that are not favourable to both sides with win-win arrangements. The Attorney-General's Chamber now allows greater flexibility in the waiver of liquidated damages and extension of time due to unforeseen delay or inaction/indecision on the part of clients. The new contracts also reflect the differences in 'foreground' and 'background' intellectual properties to signify the client's rights to own the foreground intellectual properties but not the background IP as sold by the vendor. Another important change is the removal of the retention money levied at 10–20 percent of every milestone payment made to the vendor and released upon the end of the maintenance period (normally 3–4 years).

Brunei Darussalam recognizes IP rights and strictly enforces the Trade Marks Act 2000 together with the Orders on Patents, Copyright, Industrial Designs, and Layout Designs of Integrated Circuits. In December 2000, the Electronic Transactions Order 2000 came into effect. Its main purpose is to promote public confidence in the integrity and reliability of electronic records and electronic commerce, and to foster the development of electronic commerce through the use of electronic signatures to lend authenticity and integrity to correspondence in any electronic medium.

Other relevant cyber laws in Brunei Darussalam are:

1. The Broadcasting (Class Licence) Act 2001, which deals with the licencing of ISPs and content providers, and the liabilities of these providers.
2. The Internet Code of Practice Notification 2001, which recognizes the roles and responsibilities of users and providers.
3. The Computer Misuse Order 2000, which seeks to control abuses, intrusions, hacking, and attacks in connection with electronic devices and information.

DIGITAL CONTENT

The rapid proliferation of local blogs is a welcome indicator of a growing community with a greater awareness and appreciation of the digital world. The blogs often display high quality graphics, digital photographs, creative work and information about local and regional events. Almost all of the sites are written in English, with a few Malay phrases inserted here and there.

The news sites, such as Brudirect (www.brudirect.com), Brunei Times (www.bruneitimes.com), and Radio Television Brunei (www.rtb.gov.bn), are among the three most frequently visited sites. They provide up to date daily news and events in English. The Malay daily news is broadcast in both the government published weekly newspaper called the *Pelita Brunei* (www.brunet.bn/news/pelita) and *Media Permata* (www.brunei-online.com/mp). The first widely known local Chinese website established in 2006 is managed and owned by Adison Marketing Services (www.e-huawang.com).

Among the academic institutions the MoE is promoting e-learning and use of digital content. In 2006 the Curriculum Department under the MoE issued tenders for the digitization of curriculum content for maths, English, science, Malay, and computer subjects at the primary and secondary levels. The digitized curriculum would be introduced to all of the state schools in October 2008. More digitization projects are expected to be 'issued for tender' in early 2009.

ONLINE SERVICES

Many of the existing e-government projects are not yet aiming to provide immediate public online transactions. Instead they are designed to provide for mostly government-to-government (G2G) online transactions. The focus of these projects is laying out information systems and information technologies in government agencies. TAFIS, one of the most successful e-government projects, provides for online transactions across all treasury/financial offices in government agencies only. It has not yet reached out to government contractors or the public.

Some have criticized the narrow definition of the concept of e-government that is currently being implemented. However, these premature assessments of 'failure' could derail the implementation of e-government initiatives as agencies attempt to shift their main focus, sequence, and approach of implementation. A mad rush to provide online services may not work to the advantage of the public or consumers at large. The budget to cover the cost of providing these services may be better used for reducing bureaucratic operating procedures, shortening approval times, and lowering fees. These three factors are more

important measures of government modernization, which is sometimes incorrectly construed as the ability to engage in online transactions.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

In 2003 the MoE introduced the International Computer Driving Licence (ICDL) program to all ICT teachers, staff, and IT project coordinators. Teachers and education personnel were strongly encouraged to acquire some demonstrable qualifications/skills in ICT while the project coordinators were all sponsored by the Ministry. There are more than seven business organizations accredited as ICDL Testing Centres. The Internet and Computing Core Certification (IC³) training is also gaining popularity among government agencies. The initial training program was a pilot project to assess the level of ICT competence among IT coordinators and selected teachers.

The new vision of the MoE is providing quality education toward a developed, peaceful, and prosperous nation. The mission is to provide holistic education for everyone to achieve their full potential. To achieve this vision and mission, the Ministry has defined teaching and learning excellence in terms of modern methodology, ICT tools, appropriate infrastructure, facilities, and benchmark processes. The quality of school education has also been defined in a broad sense to include student attainment of higher numeracy and literacy skills (including ICT skills), reduction in dropout rates, continuation into higher education, and greater monitoring and allocation of resources (including a decrease in the ratio of number of students per computer).

All the three higher education institutions, namely, the Universiti Brunei Darussalam, Universiti Islam Sultan Sharif Ali, and Institute Technology Brunei, are reviewing and repackaging their degree programs to make them more relevant in the new economy. It is expected that many of the new programs will include ICT components. Meanwhile, the new injection of funding for science and technology from the National Development Plan to researchers and academics is reinforcing the importance of ICT. Several competency centres and ICT-related training funds are being considered by various government agencies to enhance the capacity to establish, implement, and maintain ICT projects.

Meanwhile, the Institute of Public Service continues to organize and conduct short courses on IT-related subjects such as security, programming, database, project management, and audit. Regrettably, the lack of monitoring and incentive mechanisms belittles the participants' interest and commitment. The short training courses are generally not designed for any proficiency

or certification examinations. Participants who have completed the IT-related courses are not monitored to see whether the courses are appropriate to their current work. In addition, there are no financial incentives for civil servants to gain additional professional IT certificates.

In 2008, the MoE awarded a project on the deployment of e-learning systems in all of the higher education institutions ranging from GCE A-level schools to technical colleges and Universiti Brunei Darussalam (UBD). The project aims to create a blended learning environment and encourage the creative utilization of Web technologies to support teaching and learning. Each institution has a customized learning management system (LMS) that enables teachers/instructors to upload and share their content, and students to download the content using the Internet and participate in online forums. The LMS is based on Wizlearn 8.0, which has been successfully implemented at the National University of Singapore. A specially developed authoring tool called Ultranote is available for all lecturers to create simple content that is compliant with Sharable, Content Object Reference Model (SCORM) standards. In addition, an instructional design lab at the SEAMEO VOCTECH Centre serves as a specialist lab for teachers who wish to explore and develop more advanced digital learning content. Apart from numerous training sessions on using the LMS and instructional design, an instructional design portal is being launched to support this mass digital content development initiative.

However, not every e-education project in the country is turning out as planned. A case in point is the supply of interactive whiteboards to schools and higher education institutions. The main objectives of the project were to introduce interactive whiteboards and encourage teachers to make use of the new device to enhance classroom teaching. About one to three sets of whiteboards with multimedia projectors were delivered to every school in the country. In hindsight the project should have included desktops/notebooks and more training during the implementation and maintenance stages. Because it was the first time for many teachers to use interactive whiteboards in class, the adoption varied greatly among teachers and schools. Most of the teachers who attended the training did not train other teachers. Many opted not to use the interactive whiteboards ostensibly because: (*i*) the computers that were pulled from the lab are not properly set up; (*ii*) it is difficult to book the few whiteboards available in the school; (*iii*) there is a limited number of software packages to support the effective use of the interactive whiteboard; and (*iv*) it is easier to use only the multimedia projector, without the interactive whiteboard. Thus, the full impact or success of the project cannot be properly ascertained. Some education analysts suggest that the MoE should quickly activate Phase 2 of the

interactive whiteboards project to salvage the first phase and get the teachers to adopt the new technology in support of the envisioned learning environment.

OPEN SOURCE/OPEN CONTENT INITIATIVES

In early 2008, the AiTi launched the Google™ Android Development Project to encourage local developers to develop Android-based programs. A number of workshops have been organized by some academics from UBD to promote greater usage of open source applications. Open source initiatives are generally welcomed and encouraged by the government. However, there is no concerted effort to promote these initiatives, which are largely driven by a few researchers in the academic institutions.

ICT RESEARCH AND DEVELOPMENT

The establishment of the IT innovation/incubation centre (i-Centre) has continued to draw attention from international incubators interested in parking their technology in the country and from young local techno-entrepreneurs. Aside from the office rentals being among the cheapest in town, i-Centre occupants receive a lot of support from the management. There are no hard rules on the types of technology that can be developed so long as they are locally registered start-up companies. Research and development (R&D) projects at the i-Centre at present include RFID, mobile phone applications, portal content management system, e-learning content development, prepaid cards, and a health information system.

However, the absence of any commitment from government agencies to adopt the incubated products is clouding the future of technology incubation in the country. In general, the level of ICT-related R&D activities in Brunei Darussalam is at the infancy stage, and it requires more support from government agencies and the ICT industry.

One of the many successful e-education projects launched by the MoE is the Knowledge Management System project. It was awarded in mid-2006 to a local ICT vendor, Sprintville Technologies, in strategic partnership with Singapore-based Avant Werx Pte Ltd and Fujitsu Asia Pte Ltd. The knowledge management system is designed to cover four tracks, namely, 'examinations tips', 'event management', 'crisis management', and 'ICT in education'. The first track is targeted toward a virtual tuition centre that will allow students to use the MoE portal to access tips given by communities of teachers for GCE O level examinations. The track coordinator, who is appointed by the ministry, has the authority to nominate team leaders for each

community of practice (teachers) to lead the creation of content for this track. The event management track works with a group of administrative staff who have been organizing events, to capture their knowledge of event management. The crisis management track serves as the authority for disseminating and sharing knowledge about health-related crises in schools, such as the hand, foot, and mouth disease, severe acute respiratory syndrome (SARS), and food poisoning. The ICT in education track provides a platform for teachers to share their experience in using ICT in classes across different disciplines.

One of the interesting outcomes of the knowledge management system project is the strong cooperation and willingness of majority of the nominated staff and teachers to contribute their knowledge through the workflow process defined in the project. The concept of knowledge generation from communities of practice is realized with the right coaching and an incentive-driven environment. The project also allows for the future expansion of knowledge tracks.

CONCLUSION

The challenges of developing a significant ICT industry in an economy that is heavily dependent on oil and gas can be daunting even if budgets are not much of an issue. Oil price fluctuations have more impact on the GDP than the growth of any new industry in the country. It is therefore difficult to convince policymakers and other stakeholders about the success of new non-oil-related initiatives. Moreover, before the final outcome of any new initiative becomes apparent, there are many premature assessments by different communities that oblige policymakers to change course. As mentioned, this has been the case with the first wave of e-government initiatives that has been prematurely and unfairly assessed as failures by certain communities. Several major structural and procedural changes have been implemented in response to the negative comments.

The second challenge for the second wave of e-government projects in Brunei Darussalam is the harmonization of technical standards and policies to allow for data sharing, resource optimization, and consistency in business processes. Many government

CIOs like to think of information systems as being unique to their agencies and constituents. There is no incentive for them to collaborate and share expertise, strategically deploy resources across ministries, and enable data sharing.

The third challenge is to address the shortage of skilled human resources in government agencies to implement and operationalize the new systems. Institutional capacity in project management, change management, and realignment of stakeholder requirements needs to be developed quickly before the new and old projects settle into the system.

Finally, local SMEs and ICT vendors need to be promoted to make them commercially viable, innovative, and capable of creating high value added products, intellectual property, and services.

NOTE

1. Brunei Darussalam used to be a British Protectorate State.

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Cambodia

Pan Sorasak and **Chriv** Kosona

OVERVIEW

Between 2004 and 2007, Cambodia's Gross National Product (GNP) growth was in excess of 10 percent. Much of this growth comes from the garment industry, which employs more than 350,000 people and contributes more than 70 percent of Cambodia's exports. The tourism industry continues to grow rapidly, with foreign arrivals reaching two million in 2007. The discovery in 2005 of oil and natural gas reserves off the coast in the Gulf of Thailand will give a major boost to the economy when production commences. Mining, particularly in the north-eastern parts of the country, is also attracting significant investor interest. The government has said that opportunities exist for mining bauxite, gold, iron, and gems.

The Cambodian government is working with bilateral and multilateral donors, including the World Bank and the International Monetary Fund (IMF), to address the country's many pressing needs. In 2006, a US–Cambodia bilateral Trade and Investment Framework Agreement (TIFA) was signed and the first two rounds of discussions took place in 2007. The Cambodian government has committed itself to a policy supporting high labour standards and major initiatives in improving working conditions, and terms of employment are being introduced by the government with the support of the International Labor Organization (ILO) and the Mekong Private Sector Development Facility (MPDF). The major economic challenge for Cambodia over the next decade will be fashioning an economic environment in which the private sector can create enough jobs to handle Cambodia's predominantly young population (more than 50 percent of the population is less than 21 years old).

Over the last 10 years, the government has been proactive in the development of ICT and has encouraged both training and

development. In 2005, the Ministry of Education, Youth, and Sport (MoEYS) started to implement the Policy and Strategies on Information and Communication Technology in Education in Cambodia. This policy has developed the capacity of higher education institutes to generate graduates in the ICT field, with the number of graduates increasing significantly.

A Khmer Unicode system has been developed, and the localization of operating systems and software applications is ongoing. Open source software has been developed to bring ICT training to local communities in the Khmer language, and an MoEYS program has seen the installation of a computer classroom in every high school in the country. A Web-based trade information gateway implemented in 2008 will greatly increase the availability and quality of commercial and legal information. There are also major initiatives underway in e-commerce and trade.

The most recently available comparative statistics indicate that although Cambodia still ranks low in terms of GDP per capita (184 out of 229 countries), its GDP (real growth rate) shows that the country is the 16th fastest growing economy in the world. With political stability, increasing foreign investment, and a real commitment by the government to facilitate trade growth, markets, and living conditions, Cambodia can look forward to substantial progress in its economic improvement and poverty reduction strategies.

TECHNOLOGY INFRASTRUCTURE

Telecom Cambodia, a company owned by the government, is currently working to establish a national backbone around

the Tonle Sap ('Great Lake') and from the Lao border to the Kompong Som sea port. The Internet connection uses gateways from Thailand and Vietnam. A submarine cable connecting Cambodia directly to the international backbone via Singapore is currently under construction.

Currently, there are 13 Internet service providers (ISPs), with three more scheduled to commence operations before 2010. Connections are typically fixed-line DSL/ADSL, dial-up, Worldwide Interoperability for Microwave Access (WiMAX), and satellite. Fixed-line connections are limited to a number of provincial capitals. Dial-up is more generally available but also limited to areas served by the telephone network. WiMAX is mostly restricted to Phnom Penh. Internet by satellite is being extended nationwide, although this can be affected by extreme weather conditions during the monsoon season. In addition, fibre optic connections are becoming available with the installation of a fibre optic cable network in Phnom Penh due for completion in late 2008.

Figures from the Ministry of Post and Telecommunications indicate that there are approximately 100,000 fixed landlines (0.72 per 100 inhabitants) and 2.3 million mobile phones (16.42 per 100 inhabitants) in the country. The number of mobile phones is expected to reach 6.5 million (40 per 100 inhabitants) by 2011. There are currently four major mobile providers operating and more operators are expected to enter the market. A full range of mobile services is available, including third generation mobile phone standards and technology (3G), General Packet Radio (GPRS), and Internet connectivity.

However, according to an ASEAN e-Readiness Assessment conducted in 2001, Cambodia ranked 8th out of the 10 ASEAN countries in terms of e-infrastructure, e-society, e-commerce, and e-government. It was classified as being at the 'emerging' stage of e-readiness, characterized by the need to build basic ICT infrastructure and an ICT literate workforce. Indeed, public access to computers and the Internet is limited. Although there are now about 400 Internet cafés in urban centres and tourist destinations and computer courses are popular in the major towns, with more than 80 percent of the population living in rural areas, the majority has little or no access to computers or the Internet. The major factors influencing access to the Internet are availability of electricity, cost of equipment, and cost of connection. The rural people rely heavily on radio and television for information.

KEY INSTITUTIONS DEALING WITH ICT

The National Information and Communication Technology Development Agency (NiDA) was established in 2000 to promote ICT in the country. It is tasked to formulate ICT policy for short-, medium-, and long-term development. It is under the Office of the Council of Ministers and is chaired by the prime minister. There are five divisions under NiDA — one each for infrastructure, policy, human resource, development, and enterprise and content and applications.

The Ministry of Commerce (MoC, moc.gov.kh) continues to play a leading and innovative role in the development of Cambodia's ICT infrastructure. It oversees the development of the Web-based Trade Information Gateway (TIG), which will greatly enhance opportunities for investment by providing timely and accurate information on a wide range of topics. In addition, the MoC is currently involved in the drafting of e-commerce, intellectual property rights, and trade legislation and regulation.

The MoEYS is ensuring that ICT is integrated into the secondary school curriculum through the establishment of purpose-built computer classrooms and the use of Khmer language open source software.

The Ministry of Interior, Ministry of Justice, and Ministry of Women's Affairs are currently developing ICT-based systems that are highly specific in nature and intended to monitor, control, and eventually eradicate human trafficking in commercial sex and forced labour. This development work is being done in partnership with human rights organizations, Interpol, and other concerned bodies.

Virtually all government ministries have developed information systems in their respective fields using modern software applications and techniques, producing up-to-date statistical reports and facilitating effective service delivery. Due to the social upheaval faced by the country in the recent past, much of the ICT development work being done at government level is new to Cambodia, although most other countries in the region have had such systems for many years. However, this also means that among ASEAN countries, Cambodia is in a position to effectively 'stand back' and review what other ASEAN partners are doing in the field of ICT and to learn from their experiences.

Since the signing of the Paris Peace Accords in 1991, the UN through many of its 'family members' has continued to play a lead role in the development of the ICT sector in Cambodia. In particular, the United Nations Children's Fund (UNICEF), United Nations Development Programme (UNDP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Industrial Development Organization (UNIDO), United Nations Population Fund (UNFPA), United Nations Transitional Authority in Cambodia, World Health Organization (WHO), World Intellectual Property Organization (WIPO), World Trade Organization (WTO), and International Trade

Center (ITC) have made significant contributions in their respective fields by providing support to government ministries and non-government organizations either in the form of direct financial aid or technical support. The UN Transitional Authority in Cambodia (UNTAC) effectively created the first uses for ICT in the country with voter registration and village information data systems in 1992–1993. Updated versions of these systems are still in use.

Likewise, the World Bank, IMF, European Union (EU), and to Association of the Southeast Asian Nations (ASEAN), through various projects implemented in partnership with the Government of Cambodia, have contributed essential technical expertise, guidance, and funding for the development of ICT infrastructure.

Among the non-government and international organizations and private consultancies playing a key role in the development of the information and communications sector are:

- The Asia Foundation, which established the Community Information Centre project with US Agency for International Development (USAID) funding and which continues to advocate ICT as a crucial factor in its support of many projects in poverty reduction, human trafficking, and human rights;
- Deutche Gesellschaft fur Technische Zussammenardeit — German Technical Cooperation (GTZ), which provides technical support in GIS/GPS systems to the Ministry of Land Mapping and Urban Planning Unit;
- Open Forum, whose recent work with the MoEYS has enabled all high schools to include IT subjects in their curricula; and
- Aruna Technology Ltd, which leads in the use of satellite imagery, such as SPOT and IKONOS, and hardware (Garmin GPS), and integrates these into custom turnkey solutions for clients. Aruna has focused mostly on natural resources development and management and infrastructure applications. It has developed its own Web-based mapping software (MangoMap), which was launched as a commercial software application at Map Asia in Kuala Lumpur in August 2007. It has also produced the highly successful online 'Cambodia Atlas' (www.cambodiaatlas.com/map), which receives almost 200,000 hits a month from more than 2,200 unique users.

Private consultancies such as Smart International Consulting (www.smartconsulting.com.kh) working in partnership with the MoC and Microsoft Corporation have been instrumental in the development of websites and the localization of operating systems (OS) like MS Windows Vista, Khmer Unicode, and

software applications, as well as systems development in human resource management and Web-based applications.

Telecom providers like Camintel, Mobitel, Camshin, and Samart have all contributed to the provision of infrastructure and services. A crucial aspect of this has been the substantial reduction in telephone and Internet fees making communication affordable to many more people than before. Mobile phone coverage has been extended to the whole country, and Internet access is constantly being improved through the upgrading of existing equipment and the installation of new equipment.

ICT AND ICT-RELATED INDUSTRIES

Cambodia has yet to become involved in ICT and ICT-related industries in any significant way. While there are many retail outlets for equipment and services, they serve only the local market and they deal mainly with stock imported from China, Taiwan, Thailand, and Vietnam. A growing retail service is the provision of secondhand or refurbished computers and peripherals the total annual sales of which exceed sales of new equipment. The supply of refurbished computers outstrips the demand and it is possible to buy a complete system (such as PIII, 800 MHz, 256 Mb RAM and 20 Gb HDD) for as little as USD 75.

A number of small operations provide outsourcing services. Digital Divide Data (DDD) deals mainly with document digitization from US schools and universities and emphasizes the employment of persons with physical disabilities. Others deal more specifically with a very small local demand. The level of skill in programming, systems development, and the English language is low compared to the skill levels in other developing countries like China, Pakistan, and Vietnam where such outsourcing has become an economic contributor. Thus, the range of outsourcing services that can be offered is limited.

Twenty higher education institutes produced approximately 8,000 graduates in IT-related degree programs between 1998 and 2006. It is likely that there will be more than 10,000 ICT graduates in 2008. However, the labour market is such that the number of graduates who find employment in the ICT field each year is relatively small and most find employment in positions where their qualifications may be useful, but not strictly necessary.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

A major constraint to international companies establishing manufacturing facilities for computers/computer peripherals,

mobile phones, and the like has been the lack of clear and un-ambiguous trade legislation and protection. This is currently being addressed by the legislature and the appropriate ministries, and it is envisaged that the situation will improve over the next two years, enabling this potential market to be developed. In particular, the MoC is drafting an e-commerce law designed to achieve the following objectives: to facilitate domestic and international electronic commerce by eliminating legal barriers and establishing legal certainty; to encourage the use of reliable forms of electronic commerce; to facilitate the electronic filing of documents within the government; and to promote the efficient delivery of government services by means of reliable forms of electronic communications. It also aims to promote public confidence in the authenticity, integrity, and reliability of electronic communications, and prevent harmful conduct against computer data and information systems.

KEY ICT THRUSTS AND PROGRAMS

The Royal Government of the Kingdom of Cambodia has clearly outlined its commitment to the development of ICT and related resources over the next five years. The government's objectives are: liberalization of the telecom market and privat-ization of Telecom Cambodia, development of the national ICT infrastructure, promotion of Khmer language content devel-opment, and creation of laws and regulations on e-commerce and cybercrime.

The e-Ministry Project

In 2005, with support from UNDP the MoC launched a new MoC–UNDP TRADE Project (a follow-up to an earlier pro-gram) to strengthen its capacity to manage trade reform and Cambodia's trade integration in the world economy. The program is built around five major modules, including one focusing on updating the Diagnostic Trade Integration Study to set out a strategy for strengthening and diversifying Cambodia's export basket, and another on developing a Human Impact Development Assessment of Trade (HDIA) that is intended to sharpen Cambodia's ability to turn trade development into an instrument of poverty-reduction and sustainable human development.

In accordance with the project objectives, the MoC has initiated the implementation of its e-Ministry project, which aims to set up a model of good governance and improve the ministry's internal operations through the use of Voice over Internet Protocol (VoIP), an Intranet, and a central database. The development of Khmer Unicode and the ongoing localization of operating systems and applications software have had a

tremendous impact on the capacity of ministry staff to absorb training and develop their skills.

A major component of the e-Ministry is the Trade Information Website (TIW, www.moc.gov.kh), an online service providing information on regulations, procedures, fee schedules, penalties, and required forms. This facility will effectively provide a 'one-stop shop' where potential investors can obtain all of the information and assistance they need to establish businesses in Cambodia. It will enable local producers to ascertain market prices and conditions, and provide 'real-time' information on the weather, soil conditions, transportation, and many other issues of importance in business and agriculture. The e-Ministry project is scheduled to achieve its targets by 2010.

In response to the Private Sector Promotion Program, the MoC is developing a website for a Trade Sector Wide Approach or Trade SWAp (www.TradeSWAp.gov.kh). This Web-based project management and monitoring system is intended as a tool for the MoC and its development and Cambodian partners to optimize project activities and make them more transparent. The system is expected to serve as an example for other ministries as well.

In conjunction with the development of the TIW, the MoC has submitted a draft e-commerce law to the legislature where it is currently being debated.

National Committee for the Standardization of Khmer Script in Computers (NCSKSC)

The NCSKSC has been instrumental in meeting the need for localization in Cambodia. Working in collaboration with the Royal Academy of Cambodia and the PAN Localization Project, it has developed open source software in Khmer, in-cluding applications, operating systems, dictionaries, sorting and grouping utilities, spell checkers, and mobile interfaces. These have been distributed free of charge to the general public, schools, and educational institutes, all government branches, and the private sector. (The work of the NCSKSC is discussed further in 'ICT Research and Development'.)

ICTs in Rural and Remote Areas

Progress in developing ICT infrastructure and local content has been made mainly by NGOs. Notable examples include 22 Community Information Centres (CICs) providing low-cost Internet access in rural and urban areas. This project was estab-lished by the Asia Foundation in partnership with a number of local organizations with funding from the USAID. It has since been used as a model for other developing countries in ASEAN and South Asia.

Open Forum of Cambodia is working with the Asia Foundation in pioneering the development of Web portal content in Khmer, a module of the CIC project and the largest website in Khmer language in the country providing users with news and information on a range of subjects, including human rights, history, and the environment.

In 2008, the Informatics for Rural Empowerment and Community Health (i-REACH) project funded by the International Development Research Centre (IDRC) of Canada and run by the MoC began offering ICT-enabled services to local communities in two pilot areas, Kep and Kamchai Mear. The ICT-enabled services included access to the Internet, low-cost telephony through VoIP, computer training, and community radio and video. The project beneficiaries include local authorities, civil servants, community folk, students, and monks.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

The MoEYS is introducing various technology integration initiatives to improve education at all levels and to produce a national workforce equipped with technological literacy, critical thinking, and productive skills. These initiatives include non-formal education, distance education, training of professionals, upper-secondary education, and post-secondary education.

Since 2003, all students in teacher colleges have been required to attend two hours per week of ICT courses. All colleges now have a computer room. In 2003, the average student-computer ratio in Regional Teacher Training Centres (RTTCs) and Provincial Teacher Training Colleges (PTTCs) was 65:1. The ratio was reduced to 32:1 in 2004. This has enabled colleges to offer ICT courses.

The Open School Program was launched in January 2008 to develop Open Source Khmer Language software for all teacher training colleges and high schools in Cambodia. In addition, a new Khmer language ICT textbook will be used by all public teaching institutions to facilitate the shift to Khmer language computing in all schools and the phasing out of teaching programs in English or French. Teachers from all upper secondary schools and educators from all teacher training centres have been trained to teach Khmer language computer applications.

ICT RESEARCH AND DEVELOPMENT

The development of the Khmer Unicode has probably been the most significant event in the Cambodian ICT field. It has opened

up the market in training and systems development and it has enabled the local ICT industry to compete with neighbouring countries. However, the work leading to this breakthrough has been very challenging.

The NCSKSC had to build technical capacity from scratch, and overcome difficulties in the translation of technical concepts and language. While the staff have been trained to a sufficiently high level of proficiency, difficulties were encountered in retaining them. Due to their increased skills level, they became more 'attractive' to private industry and consequently able to obtain higher salaries elsewhere. In addition, the Khmer script is unique in Southeast Asia in that it uses under-stroke and over-stroke characters to form words, and special provisions had to be made for this.

The NCSKSC team is now focusing on a number of new and innovative projects, namely, Khmer text-to-speech research, Khmer mobile messaging content development, and Khmer optical recognition.

Another important ICT research and development (R&D) concern in Cambodia is covered by the work of the Low Cost Computing Laboratory for Education that is part of the Open Schools Program, a joint initiative of the MoEYS and the Open Institute. The Laboratory aims to identify, measure, and recommend technologies that will lead to sustainable use of ICT in education (see 'Issues in the Localization of Operating Systems and Applications').

CHALLENGES

Electricity

The adequacy of the national supply of electricity continues to be a major problem. Although the national supply company is bringing in more generators, it still meets only about 40 percent of demand in Phnom Penh, the capital, and the rest is supplied by private generators. As the national supply company adds capacity, more users switch to the national grid and the problem continues. The current high cost of fuel is also a factor and in the dry season, there are frequent power cuts in the city. Outside of Phnom Penh most provincial capitals have access to the national grid, but in many towns supply is restricted to 10–12 hours per day. In the rural areas, 90 percent of the population does not have access to generated electricity and power is supplied by 12-volt rechargeable batteries.

Alternative means of power generation are currently being investigated, such as solar power and methane gas, but the high initial cost of such installations is a deterrent. It is estimated that the installation cost per kilowatt of solar-generated electricity is almost USD 600.

Issues in the Localization of Operating Systems and Applications

More than 90 percent of computer systems in Cambodia use MS Windows operating systems. Consequently, the translation of MS Windows Vista and associated applications has been a priority. A private consultancy firm, Smart International Consulting, has been contracted by Microsoft to undertake this task. In the course of this work, two critical issues have been identified which are indicative of the degree of difficulty involved in such an undertaking. The first of these is related to the structural differences between Khmer and English.

Khmer, the language spoken in Cambodia and parts of Thailand, Laos, and Vietnam, has its etymological base in the ancient languages of Sanskrit and Pali. Originally it was the main language of the Khmer Empire that covered most of Southeast Asia. Over the centuries, as political boundaries changed, the language was modified to suit local needs in Thailand and Laos. The Cambodian language is widely regarded as the only language that has remained true to the original. The Cambodian government and the Royal Academy wish to preserve this cultural aspect of the language.

The Cambodian dictionary was recently updated by the Royal Academy. However, this update did not cover technical words and expressions. Many of the words and expressions commonly used in ICT are relatively recent and have no equivalent in Khmer. Prior to the development of Unicode, it was possible to use Khmer fonts within English language applications, but this was limited to user input. Menus, filenames, folders, and help-screens were still in English. A review of training materials used in computer training schools illustrates the problem: as much as 50 percent of the content is in English because there is simply no Khmer translation. There are also grammatical and structural differences between Khmer and English, which means that even where words or phrases may translate directly, the meaning changes depending on the context.

The second issue is the shortage of appropriate human resources. Less than 1 percent of the population has access to personal computers and although computer training schools proliferate throughout the capital, many of the training materials use English technical expressions. The universities are producing more than enough ICT graduates to meet current demand, and English language skills are increasing rapidly, but there is an acute shortage of people with combined IT and English skills developed to the level required for the translation of ICT operating systems and applications.

The issues outlined above are relevant to all fields where technical expressions abound (e.g. engineering, medicine, and finance). However, computer technology and usage is common to all and it is arguably one of the most important technical skills for people to acquire to facilitate national economic development. Consequently, accurate translation of computer terminology is of paramount importance.

(Sources: Institute of National Languages at the Royal Academy of Cambodia 2005; Virak 2007)

Cost of Equipment

Secondhand, Internet-capable computer equipment can be obtained for as little as USD 65. But this is still beyond the means of most families outside of a few major cities where the monthly income can be as low as USD 25. Internet charges at private shops supplying the service have dropped from a high of USD 10 per hour 10 years ago to USD 0.25 per hour at present. But outside of Phnom Penh, hourly rates vary from USD 1 to USD 4. Internet installations in private homes and businesses can be had for as low as USD 40 per month, but access speeds are slow. A satellite connection at 2 Mbps is USD 3,000.[1]

Limited Coverage of ISPs

Currently, the only Internet supplier with nationwide coverage is Camshin. However, the satellite-based service is affected by adverse weather conditions such as low cloud ceiling, rain, and thunderstorms during the monsoon season from April to December. The fixed-line operators are expanding their customer base rapidly, but only in the major cities and towns where lines are available. The recent introduction of GPRS and 3G capable mobile phones has resulted in greater accessibility throughout the country, but at a relatively high cost, and these are generally only suitable for email. Relay stations are continually being

built and services will improve accordingly. As customer bases increase in size, costs will be further reduced.

Digitization of Content for Websites

Few Khmer language websites are available on the Internet, partly because of lack of development capacity and partly because of the difficulties posed by the Khmer script. With the introduction of Khmer Unicode and the increased localization of applications software, there will be a substantial increase in the number of available sites and the quality of content. However, the quantity of content will remain an issue for some time. Although most of the documentation produced in the last 10 years has already been digitized through the use of computers in government departments and other organizations, a wealth of historical information is in written form only and digitizing this will be a major effort.

Exposure and Experience of Users

While computer usage is increasing in industry and commerce, most businesses rely on old methods of information storage and retrieval. The ICT sector lacks experienced professionals with the capacity to develop effective electronic retrieval systems such as databases that can be Web-based, and expertise in content management systems is generally limited to foreign consultants, with a few notable exceptions. This situation will be resolved in time, with an increased realization of the importance of ICT skills.

CONCLUSION

In summary, Cambodia has come a long way in the last 10–15 years not only in terms of ICT-related issues, but also socially and economically. The statistics quoted in this chapter do not adequately reflect how much progress has been made. Very few other developing countries have experienced the social and civil upheaval that Cambodia faced in the second half of the 20th century, which makes most statistical comparisons misleading. It would be more accurate to take what is happening now — the changes and improvements that are taking place almost on a daily basis, together with the infrastructural development — and look at what is possible, or indeed probable, in the next five years.

Standards in educational institutions are being upgraded regularly, legal processes are being put in place to safeguard intellectual property rights, investment and business regulations are being modernized, and access to information for business purposes is being streamlined. It is true that Cambodia does not

have the English language skills of countries such as India and Pakistan, which has enabled them to become market leaders in ICT industries like outsourcing and telecommunications. Nor do Cambodia's ICT professionals have the programming skills of the Vietnamese that have enhanced Vietnam's ability to compete in systems development outsourcing. However, Cambodia does have a very steep 'learning curve' and it can learn through the experiences of other developing nations.

Much is being done by the government and its partners in development, such as non-government and international organizations, community-based self-help groups, and many teams of volunteers in fields like education and self improvement. All these will ultimately come together and empower the Cambodians to hold their own with any nation in the world in ICT and other fields. The next two years in particular will be important for the country. Many of the current plans will either be implemented or be ready for implementation, and most of the old constraints have been reduced or eliminated. There is political stability, educational facilities are improving, and more Cambodians are going abroad to study in international universities and returning with valuable skills and knowledge to contribute to the development process. With this increased knowledge and an effective economic investment infrastructure, including appropriate legislation, brought about by the innovative and cost effective use of ICT, the future for Cambodia is bright indeed.

NOTE

1. All prices quoted are as of February 2008.

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China

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Total population	1.321 billion (as of December 2007)
Literacy rate	Adult literacy: 9.06%
	Adult male: NA
	Adult female: 4.13%
GDP per capita	USD 2,707.2
Computers per 100 inhabitants	64.1 (Internet accessible)
Fixed-line telephones per 100 inhabitants	28.1 (as of 2006)
Mobile phone subscribers per 100 inhabitants	39.23 (as of March 2008)
Internet users per 100 inhabitants	16.15 (as of November 2007)
Domain names registered under .cn	9 million (as of November 2007)
Broadband subscribers per 100 inhabitants	4.4 (as of April 2007)
Internet domestic bandwidth	321Gbps (as of June 2007)
Internet international bandwidth	368,927 Mbps (as of November 2007)
(Sources: China Statistics Press 2007; CNNIC 2007a)	

TECHNOLOGY INFRASTRUCTURE

In 2007, China's national cellphone penetration rate was 41.6 percent, 6.3 percent higher than in 2006; the number of Internet users reached 210 million, a 70 million increase over 2006; computer penetration among urban residents was 59.7 personal computers (PCs) per 100 households, a 15 percent increase; and colour TV penetration was 151 sets per 100 households, a 5 percent increase.

Investment in national informatization accounted for almost 10 percent of the nation's total infrastructure investment. E-Commerce expanded, accounting for 40 percent of the sales of large and medium-sized ICT enterprises.

According to a survey report on Internet development in rural China (CNNIC 2007c, p. 7), by June 2007, the rural netizen[1] population had reached 37.41 million, about a third of the urban netizen population of 125 million. Indeed, there is a remarkable gap in terms of Internet development between the rural and urban areas. Among the 737 million rural residents, Internet users account for 5.1 percent, while among the 580 million urban residents, Internet users reached 21.6 percent. Internet-related infrastructure in rural China is relatively weak. In 2005, the average number of computers was 2.7 per 100 households in the rural areas, far lower than the 47.2 PCs per 100 urban households.

Theoretically speaking, Internet access in rural areas can be made readily available. Compared to December 2006, the number of fixed phone lines per 100 rural families has increased to 26 and the number of mobile phones to 3.8. More than 50 percent of Chinese families have fixed or mobile phones (CNNIC, 2007c).

Low family incomes account for the low penetration rate of computers and the Internet in the rural areas. In 2007 the annual net income for the average rural family was only RMB 3,587 (USD 520), equivalent to the price of a low-end desktop computer. This partly explains why more than half (53.9 percent) of rural netizens surf the Internet at Internet cafés. This figure is much higher than the national average of people who surf the Internet at Internet cafés (37.2 percent) (CNNIC, 2007c). There is a lower proportion of Internet access from homes in the rural areas also because an Asymmetric Digital Subscriber Line (ADSL) connection requires a fixed telephone line and there are fewer fixed telephone lines in the rural areas than in the urban areas.

Lack of computer facilities and lack of computer and Internet literacy are the two most important factors preventing rural residents from going online. Most rural residents (84.7 percent) get information mostly from the television. There are some efforts to expand rural Internet use, including increasing rural residents' income and computer literacy and deploying more affordable Internet facilities.

INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICTS

The main administrative body for information and communication technology (ICT) development in China is the Ministry of Information Industry. Founded in March 1998, the Ministry makes and enforces national information industry policy, and laws

and regulations on electronic product manufacturing, telecommunications, and computer software. It is also charged with the allocation of radio frequency, satellite orbit setting, telecommunication network series numbers, and domain names and addresses. Coordinating, promoting, and popularizing the national informatization process are also among the Ministry's responsibilities.

An important body under the Ministry of Information Industry is the China Internet Network Information Center (CNNIC). Founded as a non-profit organization and as the state network information centre in June 1997, the CNNIC is administratively operated by the Chinese Academy of Sciences. This Academy has formed a steering committee called the Computer Network Information Centre to supervise and evaluate the structure, operation, and administration of the CNNIC. The steering committee is a working group composed of well-known experts and commercial representatives in the domestic Internet community.

The CNNIC's responsibilities include providing services such as domain name registry, Internet Protocol (IP) address allocation, database service, and research on Internet adoption and use in China. As of December 2007, a decade since its founding, the CNNIC had carried out 21 nationwide Internet surveys. The survey reports have been cited as an authoritative source on China's Internet development. Some of the CNNIC's survey findings have been used in the computation of the National Informatization Quotient (NIQ), calculated based on 20 indicators covering six areas of China's informatization efforts, including resources development level, information network construction, information technology adoption and application, information products and services, information human resources, and information development environment.[2] The CNNIC also provides Internet technical query services and certification training, and issues website page view certifications. It maintains a cooperative relationship with many international Internet communities.

Another key institution dealing with ICTs in China is the Secretariat of the Internet Policy and Resource Committee under the Internet Society of China (ISC). The aim of the committee is to research, develop, and administer the domestic Internet, and advise the legislature on Internet-related matters. It also facilitates the development and application of Internet resources and relevant technologies.

ICT AND ICT-RELATED INDUSTRIES

China is a major importer of IT services but it is also experiencing rapid growth in the export of IT services. Since 2004, China has changed the structure of the IT industry and raised the share of IT services (16 percent in 2006). As a result of rising computer sales and Internet usage in recent years, an increasing number of local companies (Levono, Digital China, etc.) are attempting the transition from being equipment manufacturers to being professional service providers.

In 2007, China's ICT-related industries continued to expand. By the end of 2007, the ICT industry consisted of 27,569 enterprises, 53 percent of which are manufacturers and 47 percent are software makers. In 2007, the industry had a total sales revenue of over RMB 1,000 billion (USD 147 billion) and profits of RMB 50 billion (USD 7 billion). The ICT industry accounts for 5.27 percent of the nation's total GDP.

Most key ICT products, including cellphones (14 percent), microcomputers (29 percent), digital cameras (11.9 percent), integrated circuits (22.6 percent), and colour TVs (0.7 percent), saw a steady production growth in 2007. Sale-production ratios for cellphones, computers, and colour TVs reached over 98 percent and profits in the computer, home AV, and electronic components manufacturing sectors increased by over 20 percent.

ICT exports reached USD 459.5 billion in 2007, a 26.2 percent increase over 2006 figures and 37.7 percent of the nation's total exports. ICT imports reached USD 345.2 billion, a 20 percent year-on-year increase and 36.1 percent of the nation's total imports. Leading the imports were computer and electronic components.

This expansion of trade in ICT products may be partly attributed to the nation's 'Go-out' strategy in which the government encourages Chinese enterprises to actively pursue international technological cooperation and exchange through favourable taxation and investment policies. A few domestic enterprises have set up research and development (R&D) centres overseas, bringing Chinese enterprises closer to the world in terms of technology advances.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

In 2001, the Ministry of Agriculture released the 10th Five Year Period (2000–2004) Rural Market Information Service Action Plan, which aims to build an information system that would collect and communicate agricultural product information to farmers in a more timely and accurate manner. The plan envisions a system encompassing TV, radio, newspapers, and the Internet in most counties, key agricultural enterprises, and intermediary agencies within 3–5 years.

China's 11th Five Year Plan (2005–2010) stipulates as one of the government's major tasks bridging the urban–rural development gap by raising living standards, the level of welfare, and the capacity for self-development in rural communities.

Since 2006, the construction of a 'new socialist countryside' has become a principal task. The strategy focuses on rural informatization and agriculture modernization to boost rural productivity, improve rural infrastructure construction, and raise the living standards of farmers. Government subsidies are also available for the provision of dedicated government and Party networks and emergency communication services.

Relatedly, the central government issued in January 2007 its No. 1 Directive on Proactively Building a New Socialist Rural China, which explicitly requires that agricultural informatization be pushed forward. Under the plan and the directive's framework, work in four aspects has been ongoing (Jiaping 2007):

1. Construction of rural ICT infrastructure, including hardware (an information transmission network) and software (a comprehensive agricultural content database and application software like poultry or husbandry disease expert diagnosis system and systems for predicting yield, etc.).
2. Agriculture information services such as agriculture monitoring, produce and production materials market monitoring, agriculture science and technology, job market, legal consulting, and the like.
3. Information literacy for rural residents through practical offline and online training.
4. Cultivation of an informatization-friendly environment by increasing investment, breaking information monopolies and blockades, cracking down on agricultural disinformation and misinformation, regulating information services, and offering inexpensive quality services.

Various projects are being implemented at national, provincial, city, and county levels to expand rural Internet use. So far, there have been at least four models for expanding Internet use in China's western rural areas: a government-led model, an enterprise-sponsored model, a laissez-faire model, and a mixed-development model. Chinese scholars (Jingsu et al. 2008) researching Internet adoption in west rural China have concluded that to expand rural Internet use, an external push is important, but it cannot solve all of the problems; the most important approach is to cultivate a fitting social environment for Internet adoption; and neither the Internet nor any other technology by itself can work miracles overnight to make the rural areas as developed as the coastal areas.

Researchers have pointed out that the 'farmer Internet cafés' set up in villages face an identity crisis between being a public interest/non-profit service and being a for-profit (though small) Internet access provider. Usually run by a few innovative villagers, such cafés were set up in accordance with government's preferential policies in the name of public interest, which means they are largely not-for-profit. But to survive, the cafés often have to take in some for-profit business. This has caused the commercial Internet service provider (ISP) regulator to crack down on these farmers' Internet cafés. After a short period of operation, many of the cafés have to close (Jingsu et al. 2008). For ICT investors in rural informatization, the problem is how to ensure returns on investment in the face of expensive infrastructure construction and lack of content that is attractive to farmers.

China's National Informatization Development Strategy 2006–2020 stipulates that informatization legislation in infrastructure construction, e-commerce, e-government, information security, government information transparency, and personal data protection will be pushed. It also says that other relevant laws concerning copyright, protection of minors, and electronic evidence will be modified accordingly.

China's informatization legislation started in 1991 with the Computer Software Protection Regulation. By December 2005, there were 108 laws and regulations and 423 documents and circulars (Jiang 2007). National-level informatization laws and regulations include the Electronic Signature Law, Radio Management Regulation, Computer Software Protection Regulation, Internet Online Service Places Management Regulation, Internet BBS Service Management Regulation, Software Product Management Regulation, Telecommunications Services Supervision Management Regulation (Interim), China Internet Domain Name Management Regulation, and Electronic Certificating Regulation. There is also a variety of local rules and regulations on informatization.

Although laws and regulations on informatization are not lacking, there are gaps, as follows:

1. There is no overarching law on informatization.
2. Current ICT rules and regulations are too abstract, so much so that most of them cannot be enforced effectively.
3. The content of current rules and regulations overlap, while newly emerging fields such as personal privacy, governmental information disclosure, and e-transactions are not adequately regulated.
4. Most current ICT rules and regulations concentrate on developed areas of the country. Where ICTs need most development, the laws are insufficient.

To address the first gap, the Information Technology Application Law has been drafted and it is expected to be promulgated soon. Other measures taken to address the gaps include learning more from the legislative practices of developed countries, strengthening related research, and establishing an efficient and comprehensive feedback system on the enforcement effect of these laws and regulations.

DIGITAL CONTENT

By November 2007 youth under 25 years old accounted for 50.9 percent (1.07 million) of the 21 million netizens in China. As the dominant group of netizens in the country, they are considered 'the hope of China's Internet'. This generation has been very active in creating online content. According to a survey (CNNIC 2007b), in November 2007 China had 72.82 million Weblogs and 47 million bloggers, more than double the number of bloggers in China in August 2006 (17.5 million). This means that one of every four Internet users in China is a blogger. Blog contents cover nearly every aspect of life, including studies, work, travel, culture, the military, and the economy. The survey showed that 43 percent of the bloggers are male and 57 percent are female. Among the total population of netizens, males comprise 55 percent while females comprise 45 percent. This could mean that female netizens find less useful or less interesting content on the Internet compared to male netizens, and they prefer to create their own content using blogs (Sina. com 2007).

In early 2006, there were only about 30 Web video providers in China. But by the end of the same year, the numbers had reached more than 250. In April 2007, daily views of 56.com, the country's biggest Web video provider, reached 8 million, as opposed to 100 million daily worldwide views of Youtube. According to a report by iResearch, a media research consultancy firm in China, more than half of the Chinese netizens viewed Web videos in 2006. The sharp increase of Web video providers in China was spurred by the influx of venture capital, which has reportedly infused USD 100 million to start Web video companies.

Given the current low penetration of digital video recorders in China, the country's Web video providers take more video content from traditional TV broadcasters than from individual amateur videographers. This often infringes upon the copyright of the TV broadcasters, who are calling for regulation. Some video sites offer pornographic and violent content, while others have their own video host people, reporters and programming, often without licence or permission from the broadcast regulator. Licences have been given to only about 180 traditional TV broadcasters. Most online video providers are unlicenced (Xiaoqiao 2007).

In addition to consumer-driven online content creation, the Chinese government has taken measures to enrich the Internet with content that meets the needs of rural residents. The Ministry of Culture and the Ministry of Finance have started the China Cultural Resource Sharing Project, which will invest RMB 2.47 billion (USD 0.36 billion) between 2007 and 2010 to support digital content creation in western villages and counties. Province-level investment will also be increased to strengthen ICT content development (see 'Online Wisdom Debunks Bogus Tiger').

Online Wisdom Debunks Bogus Tiger

On 12 October 2007, Xinhua News Agency reported that a farmer in central China's Shaanxi Province had spotted a South China tiger believed to have been extinct for 20 years, and that he had captured it on film.

The news was soon publicized widely by the local government, who released one picture of the tiger to the public. But one day after the photo hit the Internet, netizens began speculating that the 'tiger' was actually a paper model doctored with Photoshop. Some accused officials of using fake photography to promote tourism. The farmer and the Shaanxi Provincial Forestry Bureau, however, insisted that the photo was real. The farmer was in fact given a sizable reward by the Forestry Bureau which is responsible for sustaining endangered species and for promoting tourism.

Later, a team of graduate students at the National University of Defense Technology in Hunan Province released a comprehensive analysis of the photos. The team concluded that the tiger in Zhou's photos is 99.86 percent identical to an image on a wall hanging. In answer to the objection that Zhou's tiger 'blinked' in certain photos, the team convincingly demonstrated that any eye movement was simply the result of motion blur.

The ensuing online firestorm pushed the national media to investigate for possible fraud. Finally, higher forestry authorities stepped in and after a probe admitted that the tiger was bogus. One blogger wrote that the incident showed that 'the government agency's credibility is on the edge of extinction in China'. The Southern Metropolis Daily noted that 'the era when people blindly believe what the government tells them is over. Likewise, the era when the people are too afraid to speak out is also over'.

(Source: Duerme 2007)

ONLINE SERVICES

During the 10th Five Year period, e-government was given emphasis to help improve the efficiency of government, economic restructuring, market regulation, and social administration. However, current e-government services focus mainly on providing public information and not on streamlining internal processes. Moreover, each government is building its own network and system, thus making cross-governmental information sharing difficult. The hope is that by 2010 a national e-government network and governmental information sharing system will be built, to enable 50 percent of government administrative licencing and approval work to be completed online.

As for e-commerce, China's e-commerce transaction volume in 2006 totalled RMB 1,500 billion and e-procurement by the nation's 9,267 large and medium-sized enterprises reached RMB 592.8 billion (iResearch 2007). But e-commerce among small and medium-sized enterprises, which totalled over RMB 30 million in 2006, has been somewhat underdeveloped, with only 28 percent of them having used e-commerce in 2006. This means that there is a huge growth potential for e-commerce in this sector.

In the first 10 months of 2007, e-commerce sales by individuals accounted for 0.8 percent of the country's total retail sales, representing a threefold increase over 2006 figures (iResearch 2008).

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

China began to consider software engineering as a serious discipline around 1982. The program to improve Chinese software engineering practices is in full swing in the universities. Chinese officials recognize that for China to become a major outsourcing alternative for the rest of the world, its software professionals must be able to communicate in their customers' native language, usually English.

China is now the world's largest computer hardware producer and it hopes to consolidate its local innovation work. This in turn means it has an increasing demand for workers with consummate knowledge and computer literacy. However, there are significant hurdles. Statistics show that 40 percent of China's rural labour force has had only primary schooling or less and only 12 percent has reached senior high school level. Ninety-two percent of China's illiterate population is in the rural areas where there is poor education infrastructure (Qi 2008). In 2004, computer application in the nation' primary and secondary schools was 36 percent and only 16 percent of teachers had taken

ICT training. Through a number of pilot programs, the Chinese government is aiming to provide 90 percent of elementary and secondary schools with Internet access and for them to offer at least one ICT course for all students by 2010.

China's ICT-related education and capacity-building programs fall into two categories: widespread institutionalized distance education, and small pilot programs pushed by concerned governmental departments. The development of distance education in China has undergone three phases: correspondence education, TV and radio (mostly conducted by China Central TV University), and ICT-based distance education. In 1998, the Ministry of Education pilot-tested Internet-based distance education in four universities. This was soon expanded to 45 universities and by 2004, the volume of distance education enrolment equalled the volume of full-time student enrolment. In recent years recruitment has increased 150 percent to meet the growing market for distance education.

But despite the impressive expansion in student enrolment, China's distance education provision is challenged by low computer penetration, slow Internet speeds, expensive Internet use fees, and poor quality broadband multimedia course provision. Other problems include lack of learner engagement and lack of laws, such as a Distance Education Law, that will regulate the distance education market, which now has more than 70 players offering courses of varying quality (Jianfang 2007). Program discrepancies and differences are among the factors that prevent wide recognition of distance education in China.

The Ministry of Agriculture has 16 projects for farmers of which 10 are concerned with farmer training and rural ICT development. The China Central Organization Department will pilot test distance education for rural party-member cadres in nine provinces with the aim of putting in place a rural party-member cadre distance education network by the end of 2010. The training programs for the agricultural sector aim to increase the information literacy of rural residents using practical textbooks and flexible methods combining face-to-face interaction with distance education and ICT-supported learning. Literate and entrepreneurial farmers wanting to use ICT to gain an edge in their business are core trainees in these programs. This group of trainees, who are mostly opinion leaders, are expected to set an example for other rural residents.

OPEN SOURCE/OPEN CONTENT INITIATIVES

Internet developers and researchers have long been working to develop China's own computer operating system, but with little success. A breakthrough is being sought via open source software.

Currently there are two organizations pushing the open source software movement in China: the China Open Source Software Promotion Association and the Linux University Promotion Association. On 17 December 2005, the FLOSSWorld Annual World Conference was held at Tsinghua University, Beijing. Twenty Chinese open source software experts spoke at the conference about the open source situation in China. The conference reached a consensus that integrating open source software with next-generation Internet is an effective way to make China's voice heard in global technology development.

According to Professor Ni Guangnan (*Guangming Daily* 2006), an academician of the China Engineering Academy, the challenges to open source software use in China include how to build open source software communities to supplement the development by enterprises, how to create a viable business model for enterprises using open source software, and how to make full use of open source software to succeed in start-ups.

Meanwhile, the open content movement is being pushed online mostly by bloggers and podcasters. Chinese netizens are still in the early stage of knowing about Creative Commons (CC) licencing. According to a survey released on 12 December 2006, most Chinese respondents know little about CC agreements or of the existence of a Chinese version, while 27 percent of the respondents said they didn't know them at all (Yang and He 2008).

Current efforts to introduce CC licencing have run across three major challenges. First, the CC agreement was originally created to fight innovation stifling copyright overprotection in the United States, whereas copyright protection in China is weak rather than strong. Second, in China, CCs are used mostly in the blogging and podcast spheres where quality content is still lacking, so CC adoption may not spur as much innovation as expected. Third, CC licencing can be abused by unauthorized parties and thus incur legal risks for CC content users (Yang and He 2008).

ICT RESEARCH AND DEVELOPMENT

The state council indicated in December 2005 that efforts should be exerted to enhance capabilities in innovation, importation, absorption, and re-innovation, and to develop the core industries such as integrated circuits and software. Furthermore, the 11th Five Year Plan enshrines China's new economic policies of relying on rural development and scientific and technological innovation.

In line with these policies, R&D expenditures will be increased annually to 2.5 percent of Gross Domestic Product (GDP) by 2020. A set of incentive policies favouring innovation-oriented start-ups and knowledge-based enterprises was issued in February 2006. Among others, it provides for the deduction of R&D expenditures from annual tax returns at a rate of 150 percent, and it gives priority to China-made innovative technologies and products in government procurement.

For some time now China has been working on its own proprietary computer chips. In 2007 the Loongson microchip designed and manufactured by the Computer Institute of the China Science Academy was purchased by ST Microelectronics (ST), the world's fifth largest semiconductor company. The company is authorized to produce and sell the chip globally. The deal signals the successful integration of the Loongson chip in the global chip production chain (Jongo and News 2007a). The Loongson CPU is a 64-bit Microprocessor without Interlocked Pipeline Stages (MIPS) III Reduced instruction set computer (RISC) processor. It works with only 5–7 W power (4.07 W in recent tests), which is a fraction of the power needed to run AMD or Intel products.

Meanwhile, China is set to unveil the first ultra mobile PC using domestic microprocessor technology with chip design technologies transferred from the US firm AMD (Jongo and News 2007b).

CHALLENGES AND OPPORTUNITIES

In 2007 China's economy underwent significant changes as evidenced by the rapid appreciation of the Chinese currency; the promulgation of the new Contract Law; the unification of taxes leveled on domestic and foreign enterprises; and the adjustment of export tax rebates. All of these changes have nearly cancelled out the comparative cost advantages enjoyed earlier by China's exports, 85 percent of which consisted of electronic products (Industry 2008). The changes have also caused the affected enterprises to adjust their trade methods or shift investments to other counties such as the Philippines and Vietnam.

Another challenge for China's ICT industry has to do with the shift of outsourcing to and increasing integration of manufacturing and non-core services. Chinese enterprises, most of which have rather narrow business scopes, need to integrate their resources in the face of heightened competition.

A third challenge is the need for Chinese manufacturers of electronic and information products to meet eco-design of energy-using products (EUP) requirements. The European Union (EU) is the biggest importer of China's electronic and information goods, importing over USD 60 billion worth of such products (including colour TVs, computers and monitors,

electricity chargers, and printers) in 2007. Over a third of these exports to the EU will now be subject to EUP requirements (Industry 2008), which will certainly bring more pressure on Chinese manufacturers to increase product quality.

Other challenges include lagging after-sale services caused by rapid product updates, and electronic waste recycling.

On the other hand, a number of opportunities are available for China's ICT industry. For one, the third generation (3G) licence issued to three major telecommunications operators in January 2009 will boost infrastructure construction and user consumption. Second, with the opening up of China's financial industry since 2006, more foreign-owned banks are coming into China to set up branches and financial networks. This will give momentum to ICT development in China. Third, the 2008 Olympics in Beijing resulted in heavy investment in digital TV, MTV, and 3G technologies, as well as brick and mortar infrastructure con-struction (Enet.com 2007).

History has repeatedly proven that change and even crisis can speed up technology adoption. China is in a period of transition, with its economy, society, and politics undergoing dramatic changes. As China becomes more market-oriented, business organizations will adopt ICTs and boost information processing. The country now has 2.1 billion Internet users. The habituation of e-life in the years ahead will push the informatization process forward.

NOTES

1. According to the definition by CNNIC, a netizen refers to any Chinese citizen who uses the Internet more than one hour on average per week.

2. In 2007, the China Network Information Center changed its definition of netizen from 'any Chinese citizen who uses the Internet more than one hour on average per week' to 'any 6-year-old or above Chinese citizen who used the Internet within the past six months'.

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Hong Kong

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Total population	6.93 million[a] (mid-year 2007)
GDP per capita	USD 29,900[a] (2007)
Computers per 100 inhabitants	Financial services, trading and logistics, tourism, and producer and professional services[b]
Fixed-line telephones per 100 inhabitants	59.3[c] (September 2008)
Mobile phone subscribers per 100 inhabitants	160.8[c] (2008)
Internet users per 100 inhabitants	64.8[d] (age 10 and above)
Domain names registered under .hk	172,551[e] (2008)
Broadband subscribers per 100 inhabitants	27.9[c] (2008)
Internet international bandwidth	127,495.50[c] Mbps (September 2008)

(Sources: [a]HKTDC 2007; [b]Census and Statistics Department HKSAR 2005; [c]OFTA 2008; [d]Census and Statistics Department HKSAR 2007b; [e]HK Domain Name Registration Company, Inc.)

OVERVIEW AND TECHNOLOGY INFRASTRUCTURE

In 2007, the Economist Intelligence Unit ranked Hong Kong fourth in the world and first in the Asia Pacific region in e-readiness. As a result of market liberalization, Hong Kong offers the world's most affordable Internet connection and mobile phone service, according to a survey conducted by the International Telecommunication Union (ITU) in 2005. Hong Kong also ranked third in the world in the ITU's Information and Communication Technology (ICT) Opportunity Index, which measures the maturity of infrastructure, skills, and ICT utilization in society.

Indeed, all commercial and residential buildings in Hong Kong have a broadband connection. External telecommunication capacity reached 1.596 Gbps in June 2007. Mobile phone penetration rose to 139.8 percent in 2007, a great leap from 104 percent in 2003.

The Census and Statistics Department (2007) reports that 74.2 of Hong Kong's 2.3 million households have personal computers (PCs). Broadband household Internet penetration increased from 50 in 2003 to 74.8 in 2007. Not surprisingly, young people, especially those in the 10–14 age group, use computers the most: 98.8 percent reported using the Internet at least once in the 12 months before the survey. The disparity between genders is minimal: 98 percent of males versus 99 of females. Among primary and secondary school students, 96.7 had computers at home in 2007, of which 97.6 had access to the Internet. Utilization of ICT among senior citizens remains low: only 5.8 percent of those aged 65 and above reported having used the Internet in the 12 months prior to the survey. But there is a substantial difference between the two genders in the 65 and

above age group: 86 percent of males versus only 3.2 percent of females. The disparity might be a reflection of the gender disparity in literacy in the older generation.

Computer users are likely to be more educated and economically more active. Only 21 percent of those without any schooling or who attained only primary education are computer users. In contrast, 75 percent and 96 percent of those who attained secondary and tertiary level of education, respectively, reported using computers. Computer users among those who are economically active increased from 59.5 percent in 2004 to 75.4 percent in 2007, an indication that the economy is demanding a more ICT-skilled workforce. In fact, Internet penetration in business increased from 47.5 percent in 2003 to 59.8 percent in 2007. Moreover, 59.3 percent of all establishments reported engaging in electronic transactions in 2007.

In a survey conducted in February 2006 by the University of Hong Kong, six disadvantaged groups were identified and investigated: single parents with at least one child aged below 18; adults aged 60 or above; children in households with income lower than half of the median household income; new arrivals; female homemakers whose highest level of education is primary school; and persons with disabilities and/or chronic illness. The report indicated that people with disabilities were the most far behind in ICT utilization and knowledge. Among the various types of disability, the hearing impaired scored the lowest. The report was well received by the government and a decision has been made to regularly update the indicators used in the study. A large-scale follow-up qualitative study has been launched to study barriers to ICT for various disadvantaged groups.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The development of the local ICT sector is due to the efforts of several institutions and organizations in Hong Kong. Nine of them are introduced in this section.

The Commerce and Economic Development Bureau (http://www.cedb.gov.hk/) consists of the commerce, industry, and tourism branch; the Communications and Technology Branch; and the Office of the Government Chief Information Officer (OGCIO). The Commerce, Industry and Tourism Branch is responsible for policy regarding Hong Kong's external commercial relations, inward investment promotion, intellectual property protection, industry and business support, tourism, consumer protection, and competition. The Communications and Technology Branch is responsible for policy regarding broadcasting; film-related issues; the creative (including film) industry; development of telecommunications, innovation and technology; and control of obscene and indecent articles. It also oversees the operation of 10 executive arms: Invest Hong Kong, Intellectual Property Department, Trade and Industry Department, Hong Kong Observatory, Post Office, Innovation and Technology Commission, Television and Entertainment Licensing Authority, Radio Television Hong Kong, Office of the Telecommunications Authority, and the overseas Hong Kong Economic and Trade Offices.

The OGCIO (http://www.ogcio.gov.hk/) was set up on 1 July 2004 to provide leadership in ICT development within and outside the government. It provides a single focal point with responsibility for ICT policies and strategies, and the execution of information technology (IT) programs and measures under the Digital 21 Strategy, in addition to providing IT services and support within the government. The OGCIO is also accountable for the government's investment in ICT.

A high-level e-Government Steering Committee chaired by the Financial Secretary was established at the same time as the OGCIO to set the strategic direction of the e-government program and coordinate inter-agency implementation. While the OGCIO has major responsibility for implementing e-government strategy, the Committee provides sponsorship for the e-government program at the most senior level, which is essential to drive the related policy and business changes across the government.

The Office of the Telecommunications Authority (OFTA, http://www.ofta.gov.hk/) is the executive arm of the Telecommunications Authority. Its main duties are economic and technical regulation of telecommunications services, enforcement of fair competition in the telecommunications sector, and management of the radio frequency spectrum. The OFTA is also the official representative of the Hong Kong government in the ITU and in various global internet governance organizations such as the Internet Corporation for Assigned Names and Numbers (ICANN).

The Innovation and Technology Commission (http://www.itc.gov.hk/) works with other government departments, the industrial and business sectors, tertiary institutions, and industry support organizations to build a solid foundation for innovation and technology development and facilitate international trade through support for applied research and development (R&D) and technology ventures, provision of technological infrastructure, human capital formation, promotion of internationally accepted standards, and conformity assessment services. The Innovation and Technology Commission also operates the Innovation and Technology Fund (ITF) to finance projects that contribute to innovation and technology upgrading in industry. There are four programs under the Fund. The University-Industry Collaboration Program and the Small Entrepreneur Research Assistance Program are designed to stimulate private sector interest in R&D and to encourage technology start-up companies, respectively.

The government founded the Hong Kong Applied Science and Technology Research Institute Company Limited (ASTRI, http://www.astri.org/en/company.php) in 2001 to capture the promise of technological advances for Hong Kong through applied research. In April 2006, after the Innovation and Technology Commission launched the Hong Kong R&D Centre Initiative to promote applied R&D and facilitate technology transfer and commercialization under a new strategic framework for innovation and technology development, ASTRI was designated as the Hong Kong R&D Centre for Information and Communications Technologies (ICT R&D Centre) to perform leading-edge R&D for technology transfer to industry, develop technical professional, and act as a focal point bringing together industry and university R&D assets to enhance Hong Kong's technological competitiveness on a continuous basis. ASTRI builds teams of researchers who conduct world-class research and create real economic impact by transferring the intellectual property they develop in customer-focused ways to industry customers, continuously and in volume.

The Broadcasting Authority (http://www.hkba.hk/) is an independent statutory body whose role is to help broadcasters and industry players to operate in a fair, stable, and conducive environment; to ensure that the community has access to wide program choice and quality services that meet international standards; to assist the government of the Hong Kong Special Administrative Region (HKSAR) in the execution of its broadcasting policies; and to administer all relevant legislative requirements and licence conditions. The Broadcasting Authority

issues guidelines and codes of practice to enable broadcasters to have a better understanding of the community's expectations and how the regulatory framework operates. The contents of such guidelines and codes are arrived at through a process of open public and industry consultation. However, there are plans to merge the Telecommunication Authority and Broadcasting Authority into a Communication Authority in response to the convergence of telecommunications and broadcasting.

The Hong Kong Internet Registration Corporation Limited (HKIRC) is a non-profit and non-statutory corporation responsible for the administration of Internet domain names under the '.hk' country-code top level domain. HKIRC provides registration services through its subsidiary, Hong Kong Domain Name Registration Company Limited (HKDNR, https://www.hkdnr.hk/), for domain names ending with '.com.hk', '.org.hk', '.gov.hk', '.edu.hk', '.net.hk', '.idv.hk', and '.hk'.

The Hong Kong Science and Technology Park (HKSTP, http://www.hkstp.org) offers a comprehensive range of services and facilities for companies at various stages of development, including quality infrastructure and support facilities for innovation and technology development, and consulting, training and research programs to foster partnership and collaboration between industry and universities/applied research institutes. The HKSTP consists of an InnoCentre, three industrial estates, the HK IC Development Support Centre, a Wireless Communication Test Laboratory, and a Photonics Development Support Centre. It also has three incubation programs to nurture start-ups, namely, the Business Incubation Program (Incu-Tech), Design Incubation Program, and Small Technology/Design Enterprise Program. On completion of the second phase of development, the size of the Science Park would be doubled to 225,000 square metres.

Cyberport (http://www.cyberport.com.hk/) is a USD 2 billion (HKD 15.8 billion) landmark project being developed on a 24-hectare site at Telegraph Bay in the southern district of Hong Kong Island. It comprises four office buildings, a five-star hotel, a retail entertainment complex, and a deluxe residential development. The aim is to create an interactive environment for a strategic cluster of about 100 IT companies and 10,000 IT professionals that would enhance Hong Kong's edge as a leading digital city. At present, a major challenge is the Cyberport's distance which translates to long travel times for employees. Most companies have to provide their own regular transportation for staff, which lowers flexibility in deploying working time. These logistical concerns have become hurdles to the entry of new tenants, and as the discount for early tenants has ended some companies have moved out from the site. An evaluation of the Cyberport's success cannot yet be made because financial reports are still not available in the public domain. Some commentators have expressed reservations about a 'big band approach' in

building a 'Silicon Valley-like' concentration of ICT companies actually working in Hong Kong.

ICT INDUSTRIES

In 2006, imports of telecommunications equipment grew 16 percent with a value of HKD 111,301 million; computer hardware imports grew 41 percent with a value of HKD 268,290, and computer software imports grew 26.5 percent with a value of HKD 111,301 million. On the export side, telecommunications equipment and computer hardware recorded a 24 percent and 10.7 percent growth, respectively. The Trade Development Council reports that 77 percent of software and services are locally consumed, with the Hong Kong SAR government and its associated statutory bodies being the biggest group of consumers of services provided by the local ICT industry.

In 2006 about 64,000 professionals were employed in the software products and software services (SW) sectors and the information and communications services sectors. Forty-five percent of them (about 29,000) were engaged in software design and development. About 14,000 were employed in software applications and 15,000 in software related services. Software design is a high-end, high-profit domain of the industry.

R&D expenditure accounts for a small percentage of Gross Domestic Product (GDP) — 0.79 percent in 2005. Conceivably this has to do with the tendency of small business entities to invest in items that lead to an earlier cash return. Most of the 700 software product and software services companies in Hong Kong are small companies with a staff complement of 20 or fewer. About a third of these have subsidiaries in Mainland China in the form of wholly owned or joint ventures.

Rapid economic development makes Mainland China both a significant source of demand for technology and a growing supplier of ICT products. Needless to say, the growth rate and total volume of the software industry in Mainland China far exceeds that in Hong Kong. But there is a symbiotic relationship between Hong Kong and China in terms of ICT industry development. For instance, Hong Kong is strong in the area of project management and international trade. To strengthen Hong Kong's edge as a conduit to the Mainland market, the HKSAR government has established channels for cooperation with the relevant Mainland authorities and Guangdong Province in areas such as innovation, technological development, and information. A Memorandum of Cooperation was signed in June 2006 with the Shenzhen government to promote high-tech cooperation.

Meanwhile, the Hong Kong SAR government and the Central People's government agreed to further liberalize services and promote economic cooperation under the Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA).

Although the ICT industry is not included in any of the three phases of CEPA, in theory, the arrangement should create more business for ICT industry in Hong Kong. It will take time for positive results to become apparent and the implementation of CEPA requires a range of complementary arrangements, such as taxation rules and regulations, to maximize the benefit for local Hong Kong industries. Some commentators have a sceptical view of the concept of bridging the planned economy of Mainland China to the free market Hong Kong economy. Others believe that to benefit fully from the arrangement Hong Kong should have a more explicit and unified ICT Industry policy under which government support toward the development of the industry could be aligned with that in the Mainland.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Several recent initiatives have had a major impact on ICT for development in Hong Kong.

The Digital 21 Strategy was introduced by the government in 1998 to set the vision for developing Hong Kong into a leading digital city. Through a vigorous consultation process with stakeholders and the general public, it has been updated thrice — in 2001, 2004, and 2008. From an industry angle, the document is important because it sets the direction and priorities for government intervention in ICT-related areas. From an ICT for development angle, it is even more important since a comprehensive ICT policy should be concerned not only with economic development but also with social development and the long-term sustainability of Hong Kong. A major change in the Digital 21 Strategy is increasing recognition of the social impact of digital technology. The replacement of the term 'digital divide' with the term 'digital inclusion' in recent versions reflects a change in paradigm, with social inclusion now considered as a significant element in the information society. The chief executive officer (CEO) of the Hong Kong Council of Social Services, a social worker, has been appointed to the Digital 21 Strategy Advisory Committee. Still, local civil society organizations continue to press for a better balance of economic development and social development in the Digital 21 Strategy. For example, the issues of Internet addiction and Internet abuse are still not part of the Strategy.

The current edition of the Strategy reiterates government's continuous commitment to investments in e-government, R&D and innovation; championing digital inclusion; facilitating cross-boundary technological cooperation; and effective regulation of relevant ICT sub-sectors. The 2008 edition includes a plan to fur-ther improve e-government services and turn Hong Kong into

a wireless city through a combination of government investment and market forces. It also outlines specific plans and targets in IT education and programs to help students from low-income families (see 'Computer Recycling Scheme').

As part of its goal to make broadband Internet access available to every citizen, the government plans to install Wireless Fidelity (WiFi) facilities at about 350 government premises frequented by the public, such as public libraries, Public Enquiry Service Centres, sports centres, cultural and recreational centres, job centres, community halls, large parks, and government joint-user buildings. The WiFi facilities will be phased in over 20 months. As of August 2008, 130 government premises were connected; the rest will be connected by mid-2009. There will be two wireless channels: citizens can choose either the open wireless channel for general Internet browsing or the encrypted wireless channel for transmitting data or performing transactions that require further security protection. At the same time, government facilities in public streets (such as lamp poles) are being made available for operators to set up hotspots and base stations at nominal rents (GovHK 2007).

Through a major donation from a local ICT vendor, the Housing Authority has been able to set up about 1,000 WiFi access points in 120 public rental housing estates, covering about 80 percent of the public rental housing estates where a third of the Hong Kong population resides. From January 2008 onwards, tenants now have able to access the Internet free of charge at the ground floor lift lobbies and the adjoining outdoor areas from 6 am to 11 pm daily, using pre-assigned unique user identity cards (IDs) and log-ins. The Housing Authority also provides basic communal facilities such as power supply, cable ducts, and conduits at the designated areas. However, as reflected in some online discussion groups, since lift lobbies and other such common areas are not designed for such a purpose, it is a challenge to maximize the benefits of this initiative.

The Hong Kong Qualifications Framework (QF) was introduced by the Education and Manpower Bureau (EMB) in 2004 to foster lifelong learning. To this end, the EMB has assisted various industries in setting up their Industry Training Advisory Committees (ITAC), which are tasked with developing Specification of Competency Standards (SCS) for the concerned industry. The ICT ITAC, which includes major stakeholders in the industry and which was formed in July 2005, developed the first SCS for the SW sector. This will be followed by SCS for the Information and Communications Services sector. The SCS for ICT industries comprises task-based competency standards benchmarked to skills required to perform different job functions of the industry, including industry-specific knowledge, professional skills, and soft skills. It reflects industry perception of needs and areas for best practice, as well as core

Computer Recycling Scheme (CRS) for Students from Low-income Families

There are said to be around 40,000 school-age children with no computer at home. Access to computers and the Internet at home is considered necessary for children to enjoy the full benefits of all e-education programs. Thus, the education bureau of the HKSAR government acquired support from the legislative council for a computer recycling program whereby used computers are refurbished for reuse by low-income families with children in primary and secondary school. Non-government organizations (NGOs) with experience in this area were called upon to do the refurbishing, with the help of volunteers. The recycled computers are installed with some basic application software and anti-virus program and bundled with a one-year warranty and one-year free Internet connection. In addition, parents in the recipient families are required to attend IT training sessions offered by NGOs for them to learn about proper management of the computer and security issues.

An evaluation by the Hong Kong University Social Work and Social Administration Department indicates that the program has benefited around 10,000 families and although there are a few logistical difficulties, in general recipient families and the community at large welcome the program. Nearly three-quarters (73.3) of the parents/guardians interviewed found the CRS to be good or very good, and almost all (94.7) of them recommended the continuation of the project. Regarding the major objective of using computers at home to facilitate learning, there has been no overall change in the academic performance of student recipients noted so far. However, the students reported better performance in English than those in the comparison group who have yet to receive the CRS computers. An improvement in the social life at school of the CRS participants was likewise reported.

(Source: Education Bureau HKSAR 2007a; Hong Kong Council of Social Service 2008)

requirements for employability, with a view to the industry's future development. Moreover, the ICT SCS is supposed to provide a vocational competency benchmark for training, for use by both training providers and employees.

To support adoption of ICT in different business sectors, an incentive program has been designed offering financial assistance for companies, especially small and medium enterprises (SMEs), to embark on e-commerce, explore new markets, and strengthen their competitiveness. In cooperation with industry organizations and associations, the government is providing funding for implementing ICT platforms relevant to certain sectors. Currently the following sectors are covered: trade, beauty service, watches and clocks, medical and health, and social services. For example, in the social service sector a knowledge management portal for social service practitioners is being developed.

The Hong Kong Wireless Development Centre (HKWDC) is a flagship project of the Hong Kong Wireless Technology Industry Association (WTIA) with support from the government's Innovation and Technology Fund, quasi-government organizations, and all parties in the wireless industry. The 300 square metre space known as Cyberport includes well-equipped software development suites and a spacious product display area. The HKWDC aims to provide end-to-end infrastructural support (from information, consultancy, development, deployment, to product dissemination) for mobile and wireless application

development in Hong Kong. There is a unique multi-operator and multi-vendor platform with connectivity to the wireless network, including Global System for Mobile communications (GSM), General Packet Radio Service (GPRS), 802.11, Enhanced Data Rate for GSM Evolution (EDGE), and third generation (3G). Some developers are using the facilities to develop and test their applications across different operators and devices, significantly reducing their costs and development time.

The ICT Awards (http://www.hkictawards.hk/) recognizes innovation and best practice in the ICT industry. The award categories are Best Digital Inclusion, Best Business, Best Digital Entertainment, Best Innovation and Research, Best Lifestyle, Best Public Service Application, and Best Ubiquitous Networking. Each award category is organized by an industry-related organization. In 2007, Pacific Century Cyber Works (PCCW), the biggest Internet service provider (ISP) in Hong Kong, had its 3G Infotainment winning both the Best Ubiquitous Networking Award and the 'Award of the Year' for its affordability and impact on society. For just one month tariff, PCCW's 3G customers can be connected to an unlimited flow of audio and visual media content.

The Digital Solidarity Fund (DSF, http://www.dsf.org.hk) is a demonstration of tripartite cooperation (between the government, the business sector, and civil society) in promoting digital inclusion. The fund is managed by a multi-stakeholder committee chaired by an independent person. It supports a wide

range of digital inclusion programs in the community, including matching senior citizens who want to learn computer skills with youngsters who can act as tutors, as well as computer training classes for people with special needs such as the hearing impaired. As of March 2008, the DSF had given USD 600,000 to 29 community projects benefiting 147,000 citizens.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The Electronic Transactions Ordinance enacted in 2000 provides the legal framework for the conduct of e-business and recognition of digital signatures for secure electronic transactions. The list of available authentication and encryption tools is growing. For example, the Hong Kong smart identity card for all citizens contains a digitalized reserved personal identification number that can be set and changed only by the card owner. The optional storage of a recognized digital certificate is a further means of authentication. But while the public key infrastructure is available to safeguard e-commerce transactions, the user-friendliness and portability of digital certificate services are still a concern to many.

The Privacy Commissioner for Personal Data is currently reviewing the Personal Data (Privacy) Ordinance enacted in 1995. Since different components of a personal data record might require different security treatments, the protection of data privacy has become a demanding and complicated task. It is thus also important to promote respect for privacy among developers, and corporate social responsibility in the business sector in general, in addition to the provision of a legal framework.

In 2005, a 38-year-old man was sentenced to serve three months in jail for violating Hong Kong's Copyright Ordinance by distributing illegal copies of three motion pictures without authorization via a peer-to-peer (P2P) network forum. This was the world's first case in which criminal charges were filed against a user of BitTorrent technology. The Copyright Ordinance, which was enacted in 2001, was amended in July 2007 to strengthen copyright protection and make the copyright exemption regime more flexible. Major changes include new civil and criminal provisions against circumvention of technological measures for copyright protection. At the public consultation prior to the amendment, the need for balance between strengthening copyright protection and safeguarding users' needs for fair and reasonable use of copyright works was expressed.

Meanwhile, a community initiative to form Creative Commons (CC) Hong Kong is underway.

The Unsolicited Electronic Messages Ordinance was enacted in May 2007 to regulate the sending of commercial electronic messages that have a Hong Kong link. Senders of commercial electronic messages are now required to:

1. provide accurate sender information and an unsubscribe facility in a message;
2. honour recipients' unsubscribe requests;
3. not send messages to any telephone/fax numbers listed on a do-not-call register unless consent has been obtained from the registered user of the number;
4. not withhold calling line identification information when sending pre-recorded telephone calls and fax messages; and
5. not use a misleading subject heading when sending email messages.

Three do-not-call registers (i.e. for fax, short messages and pre-recorded telephone messages) started operating in December 2007 and January 2008. However, the Ordinance and the registers need to be publicized more as the registration is still quite low. A high-level task group has been formed in the government, with participation from user community and industry stakeholders, to monitor the implementation and enforcement of the Ordinance. Initial feedback from the e-marketing industry notes that the fee for using the do-not-call registers is too high.

Since 2005 there have been a few rounds of spectrum allocation and licencing of broadband wireless access services. Some testing licences have been given to academics for research purposes. The latest plan is to conduct the auction for the BWA licence in the fourth quarter of 2008.

DIGITAL CONTENT

Digital TV[1] is being offered by all pay TV operators in Hong Kong via the cable, satellite, and broadband network. As for terrestrial TV, in July 2004, the government announced the Implementation Framework for Digital Terrestrial TV (DTT). The two terrestrial TV broadcasters currently providing free content to the public are required to launch DTT by 2007 and achieve at least 75 percent coverage in 2008. Subject to further market and technical studies, the government aims to switch off analogue broadcasting in 2012 to stimulate digital switchover[2] (Commerce, Industry and Technology Bureau, HKSAR 2004). But while the community as a whole is expected to derive enormous benefits from the digital switchover, some are afraid that the switchover cost might be too high for disadvantaged groups.

Local broadcasting and telecommunications operators have indicated interest in rolling out mobile TV services.[3] A consultation exercise to firm up the implementation framework

was undertaken in April 2008 and the general expectation is that necessary legislation will follow. The OFTA aims to auction the relevant frequency spectrum in early 2009.

ONLINE SERVICES

According to the 2007 Hong Kong Information Society survey of the Census and Statistics Department, 11 percent of the establishments surveyed had ordered or purchased goods, services, or information through electronic means; 58.3 percent have received goods, services, or information through electronic means; and 1.8 percent had sold goods, services, or information through electronic means. The percentages were higher for the financing, insurance, real estate, and business services sector (4.1); the wholesale, retail, import and export trades, restaurants and hotels sector (2); and large establishments (7.3). The value of business receipts from selling goods, services, or information through electronic means was HKD 64.9 billion in 2006, representing 0.77 percent of total business receipts of all selected industry sectors. About 63 percent of the e-commerce business receipts were through a designated private network and 34 percent were through the Internet. It seems that e-business is not widely practiced in Hong Kong.

On the consumer side of e-business, a total of 5.5 million individuals, representing 97.3 percent of the population above 15, used the Octopus card to pay for transportation and 66.4 percent of the population used it to purchase goods and services in 2007. Cyber banking increased in popularity from 13.2 percent in 2006 to 16.8 percent in 2007, representing a user group of around one million. Purchasing/ordering goods and services online is still far from popular. However, there has been a noteworthy increase from 3.2 percent in 2006 to 4.2 percent in 2007.

The new government portal (www.gov.hk) was officially launched in August 2007 as the single entry point to online government information and services. The portal provides access to some 1,200 existing government electronic services and some new services. A major difference from the old portals (i.e. the government information portal and the electronic services delivery portal) is that the content is now organized based on user groups (e.g. residents, youth, non-residents, and business) and subject clusters (e.g. employment, environment) instead of departmental divisions. There is also a plan to enable bureaus and departments to upload geospatial information to augment online services and textual information. Gov.hk provides a wide range of services online, including eTax, searching for government jobs, voter registration, lodging pollution complaints, identity card renewal applications, and booking facilities.

Web 2.0 applications are being used to deliver government services to the Hong Kong public. For example, RSS feeds of government news (http://www.news.gov.hk/en/rssinstruction.htm) are being used, and citizens can make use of this site to keep abreast of government news. In another example, the Secretary of the Commerce and Economic Development Bureau created a blog (http://blog.digital21.gov.hk/en/en_index.php) about the Digital 21 Strategy during the period of consultation. The third example of a Web 2.0 application in governance is a social networking application on the Environment Protection Department website (https://wasteexchange.wastereduction.gov.hk/english/index.php) to encourage citizens to exchange second-hand items. The site supports the identification of items for recycling and enables interested users to exchange such items.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

The government published the first strategy document promoting information technology (IT) in education in November 1998 and an updated strategy document in July 2004. A third consultation is underway, with a consultation paper titled 'Right Technology at the Right Time for the Right Task'. The use of IT in education in Hong Kong aims to: (i) increase the efficiency and effectiveness of school administration; (ii) enhance the information literacy of students; and (iii) improve learning outcomes across the curriculum (Education Bureau, HKSAR 2007b).

The consultation paper currently being discussed specifies the following indicators of IT use in education in Hong Kong:

- All public sector schools have broadband connection to the Internet.
- The student-to-computer ratio is 6:1 in primary schools and 4:1 in secondary schools. This is comparable to the ratio of 5:1 in OECD countries which are more advanced in ICT integration in education, such as Australia, Canada, the United Kingdom, and the United States.
- Nearly 90 percent of primary school students and nearly 80 percent of secondary school students like to use computers to learn in class.
- Eighty-five percent of primary school students and 60 percent of secondary school students like to use computers to learn beyond school hours.
- School heads and teachers perceive ICT integration as a factor facilitating curriculum reform.
- Eighty-six percent of primary schoolteachers and 71 percent of secondary schoolteachers agree that use of IT can make teaching more effective.
- Sixty-two percent of primary schoolteachers and 52 percent of secondary schoolteachers are confident about selecting appropriate digital resources to teach.

- Over 50 percent of teachers frequently use IT in class.
- Sixty percent of parents endorse the use of IT for learning.
- Ninety-five percent of primary and secondary school students have access to computers at home, and 97 percent of them have access to the Internet at home.
- Ninety-nine percent of primary and secondary school students claim that they have knowledge of using computers.

To take IT in education forward, the government has proposed six actions:

1. Provide a depository of curriculum-based teaching modules with appropriate digital resources.
2. Continue to sharpen teachers' IT pedagogical skills.
3. Assist schools to draw up and implement school-based IT in education development plans.
4. Enable schools to maintain effective IT facilities.
5. Strengthen technical support to schools and teachers.
6. Raise parents' information literacy and assist them in guiding children to use IT at home.

Two principles underpin ICT integration efforts in Hong Kong. The first is the importance of teaching information literacy, which is the ability to source, select, evaluate, process, use, and articulate information to solve problems and generate knowledge, instead of just skill in how to use particular software or applications. The second principle is using ICT as one of many learning and teaching tools for all subjects instead of singling it out as a separate skill set to be acquired.

The Hong Kong Education City (HKEdCity) emanated from a Quality Education Fund project of a wholly-owned government subsidiary with the vision to build Hong Kong as a 'Learning City for the Learning Century' (see 'Hong Kong Education City').

OPEN SOURCE/CONTENT INITIATIVES

Since the Hong Kong government adopts a technology-neutral philosophy, use of open source software is advocated mainly by enthusiasts in the civil society sector. Although over the years the general public has learned more about open source applications, the general take up is still believed to be quite low. The Linux user group, among other initiatives, championed an open source wiki in 2007 to act as a repository of freeware and open source applications, and a resource library for GNU/Linux users and developers. Response to that wiki however is less active than expected.

The Hong Kong Productivity Council established a Hong Kong Open Source Software Centre (HKOSSC) in September 2007 to promote the adoption of open source software solutions and support the local software industry in tapping related business opportunities on the Mainland. The HKOSSC provides a range of services, including software posting, system testing, solution demonstration, proof-of-concept/pilot projects, technical support software certification, training, and research. The performance of the Centre is still unknown at this stage, but it is considered as the most organized move by any statutory body in Hong Kong in the promotion of the open source movement.

Hong Kong Education City

Hong Kong Education City (www.hkedcity.net) is the largest one-stop professional educational portal in Hong Kong incorporating information, resources, interactive communities, and online services.

HKEdCity is like an executive arm of the Education Bureau in promoting IT in education. Among its many initiatives, it operates a huge online repository of teaching resources tailored to fit the prescribed school curriculum. The resource library has over 10,000 high quality interactive teaching kits, films, animations, multimedia presentations, and the like, classified according to grade levels and subjects.

HKEdCity also promotes an e-learning platform featuring curriculum, games, creativity, communities, and tools designed to give children a happy learning experience. The student channel helps students in creative writing and project learning, and cultivates their information literacy and international vision.

HKEdCity is a popular website, with an average of four million daily page views. It has attracted 180,000 active users and the online resources are downloaded over seven million times in a year.

The biggest challenge faced by HKEdCity is to improve its teacher-friendliness and content relevance so that more teachers can use the content to enhance their teaching.

(Source: Hong Kong Education City 2008)

ICT RESEARCH AND DEVELOPMENT

ICT R&D in Hong Kong is spearheaded by ASTRI and has four technological domains: integrated circuit designs, communications technologies, enterprise and consumer electronics, and material and packaging technologies. Its research in the area of advanced wireless technology — the A8 WiFi Cellular Base Station, which won the Award of the Year in the HK ICT Award Scheme — is specially well-known. The A8 base station is deployed in outdoor environments to provide city-wide WiFi coverage. By making use of the smart antenna design and advanced signal processing algorithm, the base station can effectively provide 10 times the coverage of other WiFi base stations available in the market while minimizing the interference effect of other signals in the unlicenced frequency spectrum and requiring less than the required capital investment in wireless network infrastructure. The base station is currently being deployed in overseas markets, including the US and various Asia Pacific countries.

The 2007 Innovation and Research Award went to the Coal Mine Surveillance with Wireless Sensor Networks project of the University of Science and Technology. The research project deploys self-organized tiny sensors and powerful sensing and communication capabilities to construct an adaptive wireless sensor network system for underground surveillance in coal mines, including environment monitoring of oxygen, gas, water, and tunnel structure. The system is useful in Mainland China and other developing countries where underground mines are sites of life-threatening accidents.

CHALLENGES AND OPPORTUNITIES

That Web 2.0 technology has been gaining momentum in the last few years has opened up a wide range of opportunities in e-government, business, and the socio-political arena. The technology supports a loose and uncoordinated form of participation that seems to match very well the practical, individualistic, and non-committal traits of many. At the same time however, it can mobilize civic participation. Social and political actions, gatherings, and demonstrations are being organized online, via blogs, through Facebook, by email circulations, and the like. For example, in late 2007 a social movement initiated online for conserving a public pier that carries the collective memory of Hong Kong people caught the Hong Kong government unprepared. It also made the government realize that the traditional way of 'absorbing' public views via structured public

consultation and the appointment-based advisory committee structure are no longer effective. ICT and Web 2.0 technology in particular can be harnessed as a tool in pursuing a more balanced social development agenda. The power of ICT in mobilizing civic participation in Hong Kong deserves much more research than it is now receiving. The big challenge to the government is how to take advantage of the interactive nature of Web 2.0 in its e-government initiatives.

As a free market where productivity and efficiency are highly appreciated, Hong Kong is quick to embrace new technology that results in convenience, operational improvement, and other tangible returns. While technology itself may be value-free, its adoption is highly value-laden. One example is a case in which hundreds of unauthorized nude photos of young celebrities were uploaded on the Internet. A few people have been arrested and charged. But a heated debate ensued online, followed by a demonstration of 1,000 people accusing the police of preferential treatment in over-reacting to the incident only because a celebrity was involved. The case pits those who champion the liberal nature of the Internet and those who believe that a certain level of morality needs to be upheld.

This difference of opinion will become more apparent in the near future as the government, under much pressure, has decided to conduct a public consultation in relation to the review of the Control of Obscene and Indecent Articles Ordinance enacted in 1987. Public opinion has it that the ordinance has failed to achieve its intention to protect the under-18 from the publication of obscene and indecent articles, as the ordinance was enacted at a time when the Internet was not yet popular. Human rights activists, however, are watchful of any move that might result in even the slightest gesture of ideological control.

How to strike a balance between traditional norms against obscenity on the one hand and freedom of expression of sexuality on the other is a big challenge. Hong Kong has to prove that it deserves to be called an information society by overcoming these ethical challenges through civilized, rational debate. In this regard, the Hong Kong Council of Social Service is organizing a roundtable discussion on 'Healthy Internet Movement' to tackle a wide range of Internet abuse issues, from child pornography to Internet addiction.

Equally challenging is striking a balance between users'/consumers' need for freedom of access to information and copyright protection. The BitTorrent case is illustrative of the lack of understanding of intellectual property and how copyright should be reframed in cyberspace. It is also a reminder to content owners/producers in the entertainment industry to review their business model to make it fit the changing world.

NOTES

1. Digital TV improves reception, offers better picture and sound quality, yields higher spectrum efficiency, and enables new applications such as high-definition TV (HDTV), interactive TV, and datacasting services.
2. Digital switchover is the process where the terrestrial TV broadcasters launch DTT services and viewers equip themselves at their own costs with the necessary devices (e.g. set-top boxes or integrated TV sets) to receive DTT.
3. Mobile TV is a commercial video service for personal consumption on the move.

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India

Osama **Manzar** and Syed S. **Kazi**

Total population	1,134.4 million
Literacy rate	61% (male = 73%; female = 48%)
GDP per capita PPP (in USD)	USD 2,700 (2007)
Computers per 100 inhabitants	2.76
Mobile phone subscribers per 100 inhabitants	19.98
Internet users per 100 inhabitants	17.11
Domain names registered	200,000 (as of December 2007)
Broadband subscribers per 100 inhabitants	0.22
Internet domestic bandwidth	19–20 Tb total installed bandwidth capacity and 500–700 Gb lit-up capacity
Internet international bandwidth	27,000 Mbps (2006)

(Sources: OpenNet Initiative 2007; TRAI 2007; UNDP 2007)

OVERVIEW

India continues to extend the reach of digital technologies across the country and its performance in information and communication technology (ICT)-related fields. Information technology (IT) is a core indicator of national growth, while ICT has become an important tool in community-oriented development programs. The most impressive news to date is the 2009 launch of the '100,000 Common Service Centres' project in more than 600,000 Indian villages. The project aims to deliver basic information and digital content-based products and services to local populations.

There are now over 100 million PCs in the country, which translates to a PC penetration rate of 3 percent. According to International Telecommunication Union (ITU) estimates, India is set to surpass higher telecom targets within the next 4–5 years.

The domestic ICT market continues to expand. For instance, the aggregate revenue of the IT business process outsourcing (BPO) sector is expected to grow more than 33 percent to touch the USD 64 billion mark in 2008. The IT and IT Enabled services (ITES) sector has increased its contribution to the country's Gross Domestic Product (GDP). There has also been a spurt in investment and manufacturing activities with major IT entities like Ericsson setting up a Global System for Mobile communications (GSM) Radio Base Station manufacturing facility in Jaipur. In addition, Google has launched short message service (SMS) Search in India, allowing mobile users to get search results by sending text messages to the company.

The government spurs ICT development through various policy instruments, including the National e-Governance Plan (NeGP). There is a special focus on ICTs in education, with two rounds of inter-ministerial meets held to discuss a national ICT in education policy. Furthermore, the demand for local content in local languages is on the rise. Media content in 18 Indian languages is now available and special measures like international domain names in Hindi, Tamil, Malayalam, and other Indian languages have been launched. A major breakthrough is the Community Radio Policy framework announced in November 2006 permitting non-government organizations (NGOs) and other civil society organizations to own and operate community radio stations. About 6,000 community radio licences will be on offer across India by 2012.

However, various challenges remain for IT and ICT development in India. In the 2007 World Economic Forum (WEF) ranking of most networked economies, India ranked 50th, four places below its previous ranking. There are enormous geographic and demographic divides in ICT spread and usage, as well as lack of a strong and sustainable ICT infrastructure and weaknesses in the legal and regulatory environment for ICTs.

TECHNOLOGY INFRASTRUCTURE

According to the Telecom Regulatory Authority of India, the total number of wireline and wireless telephone connections reached 316.97 million at the end of May 2008, from 218.05 million in May 2007. The overall teledensity as of May 2008 was 27.59 percent. Also as of May 2008, the mobile/wireless penetration had reached 277.9 million. Broadband subscription reached 4.5 million, almost double the 2.46 million in May 2007.

In broadcasting and cable services, the maximum number of free-to-air (FTA) and pay channels being carried on the cable networks is 103 and 95, respectively. Apart from All India Radio,

there were 177 FM radio stations in operation as of 31 December 2007. Twenty-eight community radio stations were in operation out of 47 licencees at the end of March 2008.

The 11th Five Year Plan (2007–2012) lists several telecom infrastructure targets, as follows:

- a telecom subscriber base of 575 million, with one phone for every two rural households by 2010, to reach a rural teledensity rate of 10 percent from the present 1.9 percent;
- twenty million broadband connections and 40 million Internet connections by 2010;
- broadband connection on demand across the country by 2012;
- 3G services in all cities/towns with a population of more than 100,000; and
- broadband connectivity for every school, health centre; and Gram Panchayat (a local unit of government).

KEY ICT INSTITUTIONS AND ORGANIZATIONS

There are nationwide initiatives from government, private, and civil society organizations to reach the masses using ICTs. Many government departments and ministries, like the Department of Information Technology (DIT) at the federal level and in states like Jharkhand, Bihar, Kerala, Uttarakhand, and Gujarat have created independent organizations and companies to ensure the smooth implementation of ICT projects in partnership with private companies and local civil society organizations. On the other hand, companies like Tata, Intel, Microsoft, IBM, Wipro, AirTel, Hughes, Vodafone, and Infrastructure Leasing and Financial Services Limited (IL&FS) have gone pan India to offer content and services in education and governance. Many big companies are investing heavily in the social sector through the creation of not-for-profit organizations that bid for and implement government-funded projects. Some government, private sector, civil society, and international organizations engaged in ICT initiatives are mentioned below.

Media Lab Asia (www.medialabasia.org) is a not-for-profit company promoted by the Ministry of Communications and Information Technology. It spearheads ICT for development (ICTD) projects, the latest of which is Punarbhava.in, an interactive Web portal for the disabled. Underpinned by a vision for digital inclusion, the portal enables persons with disabilities to locate information, aids and appliances; engage in research; discuss issues; network with others; and scout for jobs. Another Media Lab Asia initiative is Gyanpedia (http://www.gyanpedia.in), a collaborative and interactive portal for learning communities. A joint effort with the Digital Empowerment

Foundation (see the following paragraph), the portal provides an open Web platform for learners through which they can share multimedia content in various learning areas (e.g. biology, chemistry, mathematics) using a bottom-up framework.

The National Knowledge Commission (NKC, http://knowledgecommission.gov.in) was established by the prime minister of India in 2005 as a think-tank focused on policies to sharpen India's comparative advantage in the knowledge-intensive service sectors. It advises the Office of the Prime Minister on policy and reforms related to education, research institutes, and intellectual property legislation, as well as the development of appropriate institutional frameworks to enhance governance and improve connectivity.

The Centre for Development of Advanced Computing (C-DAC) facilitates high-end research in science and engineering of high performance computing support to users. It also builds capability in emerging applications of grid infrastructure for global competitiveness.

The Controller of Certifying Authorities (CCA) continues to promote the growth of e-commerce and e-governance through the use of digital signatures. The number of digital signature certificates issued is expected to increase significantly with the launch of e-governance programs.

The Cyber Regulatory Appellate Tribunal (CRAT) enacted under the Information Technology Act 2000 has commenced operations. It hears appeals by persons aggrieved by an order from the CCA or by an adjudicating officer under the IT Act.

Infrastructure initiatives are being pursued by several private organizations. Intel for example launched in August 2008 a partnership-based initiative called Connected Indians (http://www.connectedindians.com/). HughesNet has created a network of more than 24,000 ICT-enabled kiosks across the length and breadth of the country to deliver various services to citizens. Companies like Bharat Sanchar Nigam Limited, Vodafone, AirTel, Reliance, and Tata have created a General Packet Radio Service (GPRS)-enabled wireless network providing not only telephone connectivity but also Internet access to the rural areas of India. Companies like Educomp, Edurite, IBM, Designmate, IL&FS Education and Technology Services, and CORE Technologies are also playing a role in ICT-enabled education in government schools.

Among the civil society organizations, Byrraju Foundation is notable for its rural BPO initiative GramIT, which is generating employment for the youth of the state of Andhra Pradesh. The American India Foundation has been working with more than 5,000 schools across 14 states to run ICT labs in government schools. Azim Premji Foundation is a non-profit organization working with more than 14 state governments to integrate ICT at all levels of education.

The Digital Empowerment Foundation (DEF, http://www.defindia.net) aims to promote digital content infrastructure across the board. Some of its initiatives, such as NeerJaal.Org (see 'Digital Content' in this chapter) and Gyanpedia.org (with Media Lab India), have been lauded nationally for their bottom-up approach.

Among the international organizations, the United Nations Development Programme (UNDP) and United Nations Educational, Scientific and Cultural Organization (UNESCO) are spearheading the UN Solution Exchange, an online community focusing on development issues and where members try to formulate actionable agendas. As of July 2008 the network had more than 1,400 members. Among the issues discussed are the Common Service Centre scheme, use of ICT in literacy programs, ICT and livelihoods, remote sensing in agriculture, setting up and running community radio stations, e-governance, and the role of ICT in local content creation.

ICT AND ICT-RELATED INDUSTRIES

IDC India reports that India's PC shipment grew by 20 percent from 5.4 million PCs in 2006 to almost 6.5 million PCs in 2007. Of the 2007 total, 1.8 million (27 percent) were notebook PCs. IDC analysts consider this to be an indicator of a maturing IT market in India.

A 2007 National Association of Software and Services Companies (NASSCOM) survey reports that the Indian IT and ITES industry recorded an overall growth of 30.7 percent in 2006–2007, with a total revenue of USD 39.6 billion. The software and services exports segment grew by 33 percent to register a total revenue of USD 31.4 billion in 2006–2007. The industry continued to be among the largest employers in India, directly employing more than 1.6 million and indirectly creating employment opportunities for an additional six million people in related industries. The industry also significantly impacts socio-economic development by contributing 5.2 percent to GDP. The NASSCOM survey projects that the overall IT software and services sector will grow by 24–27 percent and earn revenues of USD 49–50 billion in 2008.

There has been a spurt in investment and manufacturing activities. Nokia has set up its manufacturing plant in Chennai, LG Electronics has set up a plant manufacturing GSM mobile phones near Pune, and Ericsson has launched its research and development (R&D) centre in Chennai. Microsoft Corp is investing USD 1.7 billion in India over four years, while Intel has announced an investment plan of more than USD 1 billion in five years.

The telecom and IT sector is expected to attract USD 10–11 billion in investments in the next two to three years. About USD 1.5–2 billion of this is expected to go into the telecom manufacturing sector and USD 2–3 billion to the telecom services sector.

The UNCTAD Information Economy Report 2007 notes that world export of information and communication goods is led by China and India. While China tops manufacturing, India leads in software, call centres, and related services.

ICT POLICIES AND PROGRAMS

The National Broadband Policy of 2004 facilitated the adoption of broadband technologies in India.

More recently, in late 2007, the Ministry of Information and Broadcasting issued the Community Radio Policy that allows community radio to be aired on FM radio lines and community radio licences to be issued to any legally recognized voluntary organization that have been operational for at least three years. To date there are more than 100 applications for licences and government and advocacy-based NGOs are looking at 6,000 community radio stations in the next two to three years. For the education sector and the civil society network, the policy coupled with the Right to Information Act is a major step toward empowerment of the masses (see 'Jamsavad Facilitates Governance').

The NeGP formulated by the DIT includes 20 major e-governance projects across eight support components at the central, state, and local government levels. One of the 20 NeGP projects is the Common Service Centres (CSC) project which aims to set up 100,000 CSCs in 600,000 villages to serve not only as the frontend for most government services, but also as a means to connect the citizens of rural India to the World Wide Web.

Another recent major policy initiative was the re-launching of the .IN Registry in January 2005 by the DIT and the National Internet Exchange of India (NIXI). The .IN Internet domain name registration crossed 200,000 in December 2007. Four Internet exchange nodes were set up and made operational at Noida (Delhi), Mumbai, Chennai, and Kolkata.

The Mobile Grameen Sanchar Sewak (Mobile Rural Network Service) Scheme is placing telephones at the doorstep of villagers in about 12,000 villages. As a result, more than 56,400,000 villages now have Village Public Telephones. There are also efforts under the Universal Service Obligation Fund (USOF) to provide support for the setting up of wireless networks in rural and remote areas.

The DIT has also launched a Special Incentive Package Scheme to encourage investments in setting up semiconductor fabrication and other micro and nano technology manufacturing industries in India.

Jansamvad Facilitates Governance

Jansamvad is a weekly radio program used in the Sagar district of Madhya Pradesh as a public grievance redressal mechanism. The program, which is also available on the Web, enables citizens to directly address the government with their grievances and queries. It also gives information about schemes run by the state or central government.

The program was started in December 2004 when the district collector and chosen heads of the district administration participated in a live phone-in dialogue with people of the district. The interactive segment was subsequently scheduled every Monday for one hour on All India Radio. As the grievances aired in the program are sorted out within a stipulated timeframe, the program has become popular among people from all walks of life. The district administration claims that about 90 percent of citizens' complaints through the program have been resolved. Indeed, the program is credited with helping the Sagar district to rank first in the implementation of the national Total Sanitation Campaign.

More information about the Jansamvad program is available at www.sagar.nic.in.

LEGAL FRAMEWORK FOR ICT DEVELOPMENT

The Information Technology Act 2000 (IT Act 2000) is the sole cyber law of India at present. The Act provides for the legal recognition of transactions carried out by means of electronic data interchange and other means of electronic communication — in short, electronic commerce. The Act also provides for the legal recognition of digital signatures.

The draft Communication Convergence Bill 2000 (the 'Convergence Bill') is still being debated. The Bill proposes to establish a new 'converged' regulatory framework to promote and develop the communications sector, including broadcasting, telecommunications, and 'multimedia'. Until the Bill is enacted, however, the Telecom Regulatory Authority of India (TRAI, www.trai.gov.in) continues to be the prime regulatory agency dealing with the legal aspects of telecommunications issues.

A proposed Broadcasting Services Regulation Bill, 2007 seeks to promote, facilitate, and systematically develop the carriage and content of broadcasting to ensure that a wide variety of entertainment, news, views, and information is provided in a fair, objective, and competitive manner.

Meanwhile, the Reserve Bank of India has set guidelines for Internet banking and reviews them at periodic intervals.

DIGITAL CONTENT AND LOCAL LANGUAGE TECHNOLOGY PLATFORMS

The launching of international domain names in Hindi, Tamil, Malayalam, and other Indian languages is boosting the development of digital content in the local languages.

Fonts and software to enable development of websites in local languages are being distributed free of charge. At the policy level, government stakeholders have displayed a lot of interest in developing the content required for public services, especially digital content that can be delivered via mobile phones.

The annual Manthan Award (http://www.manthanaward.org) organized by the DEF continues to promote and recognize digital content in the critical areas of health, education, livelihood, community broadcasting, and e-commerce. Beginning 2008, the Award has been expanded to other South Asian countries. When the nominations closed, Manthan Award South Asia 2008 had accumulated 284 nominations. Among the 33 winners across 12 categories, Sri Lanka and Bangladesh snatched at least seven awards. The Manthan Award boasts a network of more than 1,000 organizations from eight countries that are actively involved in digital content and services for the masses. Among recent local content initiatives that have received the Manthan Award are:

- SMSOne (www.SMSOne.in), a social entrepreneurship project involving high school and college dropouts in developing short message service (SMS) as media for communicating public service and community development messages;
- www.odisha.com, the world's first news portal in Oriya, the official language of the Indian state of Orissa;
- Puzha.com (www.puzha.com), an interactive website dedicated to the advancement of the Malayalam language and literature, the development of language tools, and the archiving and preservation of the local (traditional and to some extent tribal) knowledge base and folklore of the southern Indian state of Kerala; and
- www.Raftaar.com, the world's first integrated search engine in the Hindi language, with the largest set of searchable Hindi pages.

Other notable digital content initiatives are:

- the HIV/AIDS electronic helpline managed by the Jaipur-based Health and Social Development Research Centre;
- www.indianblooddonors.com, a Web-based helpline for patients who need blood in an emergency;
- www.bhojpuria.com, an online communication and networking platform for the Bhojpuri language community, mostly found in Bihar;
- DesiCrew Solutions (www.desicrew.in), which takes BPO job opportunities to the rural masses in Tamil Nadu, thereby introducing livelihood opportunities using computers in villages; and
- www.toeholdindia.com, an e-commerce portal established by ToeHold Artisans Collaborative (TAC) to promote an export-oriented group enterprise owned and governed by artisans in 11 women's self-help groups.

The localization of the India national portal (http://india. gov.in/) is ongoing. The Hindi version of the national portal is already available. However, it is recognized that information or services will have to come from individual websites in the local languages and there are very few of these websites at the moment. Meanwhile, Google.co.in continues to offer content platforms in Hindi, Bengali, Telugu, Marathi, and Tamil.

Neerjaal.org and Local Area Portal (localareaportal.org/) are key community-oriented content projects of the DEF. Neerjaal provides Web-based multilingual information about community management of water resources, while Local Area Portal deals with diverse aspects of community life with the community itself being responsible for generating, uploading, and updating local content for local and global audiences.

ONLINE SERVICES

The biggest success story to date among online services in India is the online sale of almost 5,000 million train tickets in August 2008 by the Indian Railway Catering & Tourism Corporation Limited (IRCTC, http://irctc.co.in/).

The Income Tax Department has successfully allowed tax return filing online for individuals and organizations, while the Ministry of Corporate Affairs (http://www.mca.gov.in/) has gone fully online with the MCA-21, which is envisioned to provide 'anywhere and anytime services to businesses'.

Several new local e-government initiatives have been launched, such as the Government of Chattisgarh's Department of Food Online Paddy Procurement project; Karnataka's Nemmadi e-Governance Secretariat and e-filing of income tax returns; the Nagaland Government's e-Modop (www.emodop. com), a portal and online public grievance redress system; and the cost-effective SMS-based reporting system for tracking livestock health and breeding services of the Orissa government's Animal Husbandry and Veterinary Department.

According to the first comprehensive consumer e-commerce survey conducted jointly by the Internet and Mobile Association of India (IAMAI) and IMRB International, the consumer Internet market would reach an estimated INR 92,100 million (about USD 1,861 million). At the end of March 2007, this segment was estimated to be worth INR 70,800 million, with an average rate of growth of about 30 percent. Convenience and accessibility, as well as improvements in logistics and delivery mechanisms, have also fuelled the e-commerce trend.

Key banks have expanded their online banking operations. While the State Bank leads public sector banks, the ICICI Bank is leading the Internet banking network in the private sector. IDC estimates that there are over two million registered users of Internet banking in India. Although this constitutes only 0.096 percent of the total population, it represents 15 percent of India's Internet user population.

Online services are also provided by naukri.com, rediff.com, sify.com, and indiatimes.com, among others. Whereas naukri.com is about jobs, rediff.com, sify.com, and indiatimes.com are online portals for transactional e-commerce-enabled service providers.

ICT IN EDUCATION AND CAPACITY-BUILDING PROGRAMS

The Information and Communication Technology @ Schools Scheme launched by the Department of School Education and Literacy in 2004 has been extended in the 11th Five Year Plan (2007–2012) to include all government and government-aided schools.

At the state level, the computer-aided learning (CAL) project initiated in mid-2004 in Andhra Pradesh, in collaboration with the Azim Premji Foundation (www.azimpremjifoundation. org) is linked to the '1,000 schools computerization project', a five-year project of the government of Andhra Pradesh. Under the Sarva Shiksha Abhiyan scheme (Literacy for All scheme), the government gives each district INR 5,000,000 to establish CAL centres.

In south India, the Kerala government is revising e-governance and e-literacy efforts through knowledge transfer and train-the-trainer programmes. The Government of

Puducherry, for its part, has decided to launch an e-learning program in schools through a project called Smart School System.

The Global e-Schools and Communities Initiatives (GeSCI, http://www.gesci.org), Quest Alliance, Azim Premji Foundation, DEF, and American India Foundation (http://www.aifoundation. org) are the key national-level organizations working in the ICT in education sector. The DEF's Gyanpedia interactive and collaborative portal with Media Lab Asia is a comprehensive, multilingual, dynamic virtual platform for countrywide content exchange among schoolchildren and teachers. The GeSCI is implementing the Rajasthan Education Initiative (REI).

In November 2007, NIIT Technologies, one of the biggest Indian IT companies offering IT education nationally and internationally, announced its strategic alliance with US-based NComputing to help reduce the cost of computing in schools by 50 percent to enable schools across India's cities, towns, and villages to offer computer education to its students at a fraction of the cost.

With the help of US-based IT training community New Horizons and with funding from the North Eastern Council, the Mizoram government in north-eastern India plans to develop the ICT skills of 200 educated but unemployed youth in the coming months. Meanwhile, under its Khulja Sim Sim program, the Delhi government aims to set up touch screen and computer kiosks bundled with relevant content to entice out-of-school children to go back to school. The Confederation of Indian Industry (CII) has urged the state governments and education institutions in India to offer courses in e-publishing.

India's biggest problem is how to provide education to the masses both at the school and vocational and higher education levels. Two government institutions that are leveraging ICTs to solve this problem are the National Institute of Open Schooling (NIOS) and the Indira Gandhi National Open University (IGNOU). The NIOS (www.nos.org) caters mainly to out-of-school children, school dropouts, and the socially and economically backward sector of the learner population. IGNOU (www.ignou.ac.in) is the National Resource Centre for Open and Distance Learning offering sustainable and learner-centric tertiary-level programs as well as skills upgrading and training. Aside from offering online courses, both institutions have put their entire curriculum online.

In a significant move, the second Inter-Ministerial National Consultation on the drafting of the national policy on ICT in school education was held on 12 March 2008 under the aegis of the Ministry of Human Resource Development. The consultation sought to involve various government departments and other stakeholders, including educational institutions, the private sector, experts, State representatives, and civil society, in the drafting of the policy.

OPEN SOURCE/OPEN CONTENT INITIATIVES

Free and open source software (FOSS) is being endorsed for e-governance and digital service offerings by both the government and private service providers in India. The Computer Society of India, a FOSS advocate, has noted that early initiatives in e-governance used multiple technology platforms, resulting in high development costs, maintenance difficulties, lack of interoperability, and lack of sustainability after the original innovator left the project. Thus, state governments and government agencies are shifting to open source. For example, the Kerala Government's IT Policy draft has identified FOSS as a major strategic component in its efforts to build an inclusive information society. Open standards like Open Document Format (ODF), which ensure the accessibility of government data, are also being adopted (see 'Draft National Policy on Open Standards for e-Governance'). However, there is an ongoing debate about ODF in online discussion forums.

In general, the use of open source is gradually changing the dynamics of knowledge creation and distribution in India. For example, Wikipedia has been providing options for open source content in the regional languages. And in a significant move the Council of Scientific and Industrial Research (CSIR) has called for an open source collaborative effort to create medicines for tuberculosis and other diseases so that more affordable drugs can be delivered to the poor.

The latest discussion is to make open source a part of the curriculum in schools and colleges. In the tertiary education sector, the Indian Institute of Technology Kanpur has launched its own learning management system, called Brihaspati, using an open source framework to build e-learning courses and deliver them across wide area networks. The Brihaspati Virtual Classroom is an open platform for learning, based on the java servlets content delivery system.

As part of continuing efforts to develop cutting-edge FOSS, Red Hat India recently announced a Linux Automation Strategy that allows an application certified on Red Hat, which is based on a wide variety of architectures, to run right from x86 to the IBM Z series to the emerging 'cloud computing' platform.

ICT RESEARCH AND DEVELOPMENT

A number of key R&D efforts in telecoms and IT are taking place in the public and private domains.

A national facility for electromagnetic interference (EMI) and electromagnetic compatibility (EMC) evaluation of electronic equipment and systems has been set up at Chennai. This is the first of its kind in India and the third in South Asia. Moreover, the government has approved a joint project for setting up Nanoelectronics Centres at the Indian Institute of Science in Bangalore and the Indian Institute of Technology. With support from the Development Gateway Foundation of the World Bank, the government is also setting up a research and training (R&T) centre in Bangalore.

Yahoo Inc. has announced a decision to open an R&D lab in India soon. Similarly, Sony Ericsson is launching a new R&D centre in Chennai. Intel has announced an alliance with 16 companies in India to expand its efforts to provide people in developing countries with the benefits of technology through its World Ahead Program in areas like health, education, and rural empowerment. Nokia has also announced fresh investments of USD 75 million in its manufacturing plant in Sriperumbudur, Chennai.

The DIT has decided to set up a Telecom Testing and Security Certification Centre (TETC) for communication security, research, and monitoring.

Media Lab Asia is also engaged in R&D to broaden access to ICT for the masses through such projects as '[Wireless Fidelity] WiFi for Rural Areas', 'Telemedicine', 'ICT for Disabilities', and 'ICTs in Education'. It received the Nasscom Innovation Award 2007 for 'Sanyog', a multilingual (English, Hindi, and Bengali) augmentative communication system for the empowerment of persons with disabilities.

CHALLENGES AND OPPORTUNITIES

India's march toward becoming a powerhouse in ICT is fraught with challenges. There is a perception that the Indian economy as a whole has not benefited from the ICT industry because of the high regional concentration of ICT activity and low diffusion of ICT to other sectors of the economy. The IT and ICT boom is visible only in special regions and locations mostly in southern India, and the concentration of skilled human resources in the IT and ICT sectors is adversely affecting other sectors of the economy. Moreover, there are questions about whether an export-led ICT strategy will enable the fruits of ICT-led development to reach the marginalized. While India needs to tackle last-mile connectivity issues, funding ICT projects outside of the IT sector is a challenge.

There are also cultural and political challenges. Studies show that a purely technocratic approach to development is having a perilous impact on local cultures and ecosystems. It is necessary to ensure equality of access to local content in different places and to enable communication and interaction at the grassroots (see 'CICs Not Living Up to Expectations'). Content creation and delivery is a hurdle. The challenge is how to use ICT tools like mobile applications in service delivery. The language and broadband issues are significant, and the impact of community radio operations will not be apparent until two to three years hence.

The standardization of ICT projects is another major challenge. There is disparity in technology selection, duplication

CICs Not Living Up to Expectations

The Community Information Centre (CIC) program (http://www.cic.nic.in/) was initiated at the behest of the DIT in 2002 for the citizens of eight north-eastern states of India, as a holistic scheme to provide various government, educational, and commercial services like access to computers, Internet and email access, telephone and fax services. Each CIC is a kiosk with 4–5 connected computers, a scanner, a fax machine, a printer, and in some cases, even video-conferencing facilities.

However, a field survey by the authors of this chapter found that most of the 457 CICs are either unused or scarcely used. The CICs are inaccessible to the masses because of their urban location and non-availability of appropriate governance and educational services. In addition, because the CIC coordinators are paid employees, they lack the initiative to entice users to avail themselves of CIC services.

of efforts, and lack of economies of scale. Moreover, there appears to be a lack of interest on the part of policymakers in scaling up successful projects.

Last but not least is the persistent need for adequate ICT infrastructure deployment across the country, especially in remote and underprivileged areas. And education and literacy for millions is critical in ensuring the success of ICT initiatives in the country.

On the other hand, opportunities and the scope to deploy ICT for holistic growth in India are equally apparent. Since most ICTD interventions are still at the pilot phase, attention can be given to their scalability and replication at a higher level. The ground-level success of ICT deployment hinges on continuous innovation, particularly to increase the efficiency and effectiveness of development processes serving the rural economy and society as well as underdeveloped communities. These ICT processes are critical in providing basic information and communication services to the public, improving the efficiency of service delivery, ensuring higher levels of transparency in government, ensuring better and fair prices for produce, serving health and education needs, and enabling people's participation in governance.

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.id

Indonesia

Donny B.U. and Rapin **Mudiardjo**

Total population	224.9 million (as of December 2007)
Literacy rate	Male: 94.5%
	Female: 89.2% (as of 2005)
GDP per capita	USD 3,843 (as of 2007/2008)
Computers per 100 inhabitants	2.8 (as of June 2007)
Fixed-line telephones (PSTN) per 100 inhabitants	3.89 (as of September 2007)
Fixed Wireless Access (FWA) per 100 inhabitants	4.03 (as of September 2007)
Mobile phone subscribers per 100 inhabitants	36.39 (as of September 2007)
Internet users per 100 inhabitants	11.1 (as of December 2007)
Domain names registered under .id	38,461 (as of June 2007)
Broadband subscribers per 100 inhabitants	0.2 (as of December 2007)
Internet domestic bandwidth	80 Gbps (as of December 2007)
Internet international bandwidth	5 Gbps (as of December 2007)

(Sources: APJII 2007; Statistics Indonesia 2008)

OVERVIEW

Indonesia is an archipelago of more than 17,000 islands with a total population of 224.9 million people. About 43,000 villages (65 percent of the total) do not yet have a telephone line. While the number of mobile phone subscribers has grown significantly, Internet and computer penetration is still low. Among those with access to the Internet, some online services like e-banking, e-shopping, and e-ticketing are becoming quite popular.

A key national ICT initiative in 2007 was the implementation of the national single window at Tanjung Priok Harbor in line with the Association of Southeast Asian Nations (ASEAN) Single Window Agreement (see details in 'Key ICT Policies and Programs'). In addition, the House of Representatives passed the Electronic Information and Transaction Act on 25 March 2008. The Universal Service Obligation (USO) policy and the Palapa Ring project are expected to play an important role in connecting the unconnected in Indonesia. There are also important grassroots ICT initiatives, such as making a parabolic antenna using a frying pan and establishing open source-based citizen Voice over Internet Protocol (VoIP) telecommunication infrastructure.

TECHNOLOGY INFRASTRUCTURE

Satellite

The Indonesian Satellite Association (Asosiasi Satelit Indonesia — ASSI) predicted that the value of the satellite service and its derivatives would reach USD 480 million in 2007, representing a 15–20 percent increase over 2006 values. By the end of 2007, transponder needs in Indonesia had reached 150 units. However, there are only 97 transponder units provided by domestic satellite while about 40 transponders still use overseas satellites. The capacity of one transponder is about 50 Mbps. The 53-unit shortage in transponders means a 2.65 Gbps shortage in bandwidth from satellite. The shortage is expected to be filled via the Telkom-3 satellite, the Palapa D satellite, and the replacement of the Cakra Warta satellite. Both the Telkom-3 and Palapa D satellites will be launched in 2009. The Palapa D has a 40-transponder unit capacity, of which 40 percent will be used by Indosat.

In 2006 the number of satellite-based services increased significantly following the issuance of the Communication and Informatics Ministerial Decree No. 13/2006, which requires companies who use satellite to register. The approximate business value in 2006 was USD 140 million from retail of very small aperture terminal (VSAT) providers, USD 196 million from telephony trunking, and USD 45 million from 14 transponders. The ASSI hopes that all operators will optimize the slot orbit and regulation support from government and use the 3.5 GHz frequency.

Phone Services

Indonesia's telecommunication sector grew by 48 percent in 2007. Active mobile phone numbers reached 80 million, representing a mobile phone teledensity of about 30 percent. Only about 8 percent of the total population have landlines, of which 3.89 are fixed-line telephones (PSTN) and 4.03 are fixed wireless access (FWA).

FWA costs even less than mobile phones. From the investment side, FWA service is much less expensive than fixed phones: building up one FWA connection service costs only USD 7, whereas the investment cost for a fixed line is about USD 500–1,000. Thus, incumbent operators Telkom and Indosat are giving priority to developing FWA and the FWA market grew to 10.5 million customers by the end of 2007.

Third generation (3G) cellular phone services, which were introduced only at the beginning of 2006, are being aggressively promoted and sales are rising. There were five 3G operators and four million 3G customers at the end of 2007. The majority of 3G customers use the service for video calls and for downloading music. 3G services in Indonesia have grown livelier with three operators (Telkomsel, Indosat, and Excelcomindo) upgrading their services to High Speed Downlink Packet Access (HSDPA) technology, which offers 10 times faster cellular access compared to the older 3G technology (i.e. 3.6 Mbps via HSDPA compared to 384 Kbps). HSDPA-based service costs about USD 38 for 1.2 Gbps of usage per month.

At the end of 2007, there were eight operators licenced to provide mobile telecommunication services. The government has declared that no new cellular telecommunication licence will be released in 2008.

Compared to other forms of telecommunication, fixed phone penetration in Indonesia is the lowest. Only 100,000 new customers were added in 2007 to the 8.7 million connections registered in 2006. The lack of growth is due to the difficulty of developing and maintaining cable network infrastructure. However, the government does not want to abandon fixed-line services and has scheduled an open bid for fixed phone services in mid-2008 under the USO program. The target is to increase fixed line telephone penetration especially in the rural areas.

Computers

PC ownership in 2007 increased by about 38.5 percent compared to 2006 figures. The Indonesian Computer Business Association (Asosiasi Perusahaan Komputer Indonesia — APKOMINDO) reported a 29 percent increase in personal computer (PC) sales, from 1.4 million in 2006 to 1.8 million in 2007. Sixty-five percent of the PC sales in Indonesia is dominated by local brands or locally assembled PCs. Notebook sales, on the other hand, are dominated by overseas brands, according to APKOMINDO. PC sales are predicted to increase by around 39 percent to reach 2.5 million in 2008.

Internet

According to the Indonesian Internet Service Providers Association (Asosiasi Penyelenggara Jasa Internet Indonesia —

APJII), there were about 25 million Internet users in Indonesia by the end of 2007, up by 25 percent since 2006. Many Internet users find the bandwidth cost in Indonesia expensive, particularly since the Internet service provider (ISP) purchasing price for bandwidth has been reduced to USD 1,800 per Mbps from a high of USD 2,200–2,500 per Mbps.

The APJII also noted that by the end of 2007 Internet traffic in Indonesia had reached 5 Gbps for international bandwidth usage and 80 Gbps for domestic traffic.

Domain Name

As of June 2007 there were 38,461 domain names under .id in the Indonesia Domain Name Registry (Pengelola Nama Domain Indonesia — PANDI). Forty-eight percent of these are commercial. There has been a 50 percent growth in the numbers over the last two years, with 18,000 domain names added since 2005.

PANDI predicts the number of registered .id domain names to reach one million in 2010. To boost the increase, it has sponsored a .id logo design contest and a writing contest on the importance of the Internet domain name. In 2007 the Department of Communication and Information Technology (Departamen Komunikasi Dan Informatika — Depkominfo) also launched the 'Dot ID Saja' program with a '.id for your id' tagline. The program aims to increase domestic bandwidth use and optimize international bandwidth use for overseas services that are accessed by many Internet users in Indonesia, like blogs, mailing lists, instant messaging, and search engines.

Local WiMAX

The Directorate General of Post and Telecommunication (Dirjen Postel) will open for tender the development of the 2.3 GHz local Worldwide Interoperability for Microwave Access (WiMAX) in 2008. The government has set aside about USD 1.93 million for this purpose. However, as of September 2008, no significant progress had been made in the tender process.

WiMAX development will involve government, the private sector, and academic institutions, including the Indonesian Institute of Science (Lembaga Ilmu Pengetahuan Indonesia — LIPI), Technology Institute of Bandung (ITB), University of Indonesia (UI), Gajah Mada University (UGM), Hassanudin University (Unhas), Technology Institute of 10 November (ITS), State Ministry of Research and Technology, Technology Research Group, PT Inti and PT Harif. Each is assigned a specific role: ITB for chipset development, Ristek through the Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknologi — BPPT) for

final terminal development, LIPI for baseband radio frequency, UI for antenna, and ITB for operating system. There will be 40 researchers from each group.

The Dirjen Postel Director has noted that WiMAX development in Indonesia will develop the local IT and manufacturing industry, which in turn will support downstream industries such as the content industry.

INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The National ICT Council (Dewan TIK Nasional — DETIKNAS) was established in 2006 to accelerate Information and Communication Technology (ICT) growth through policies that would synchronize the ICT programs of all government departments, ministries, and units. DETIKNAS has seven flagship programs:

1. e-Pendidikan (e-Education) — intended to establish an education network (see 'ICT-related Education and Capacity-Building Programs').
2. e-Pengadaan (e-Procurement) — now on a trial run at the National Development Planning Agency (Badan Perencanan Pembangunan Nasional — Bappenas) and the National Education Department.
3. e-Anggaran (e-Budget) — to merge the routine budget and the development budget into one budgeting format to reduce the intersect allocation.
4. National Single Window (NSW) — an integrated system to accelerate customs clearance, cargo clearance, and the custom facilitation process, thereby cutting the high costs associated with customs services.
5. Single Identity Number (SIN) or National Identity Number (NIN)
6. Palapa Ring — the national telecommunication backbone organized as a fibre optic ring surrounding the entire Indonesian archipelago to accelerate access, increase telecommunication quality, and ensure universal availability of the telecommunications infrastructure.
7. Software legalization program — to promote use of licensed software in government and non-government institutions, with open source software as the main choice.

The implementation of telecommunications standards, rules, and policies is the joint responsibility of Dirjen Postel, which is under the Depkominfo, the Indonesia Telecommunication Regulatory Body (Badan Regulasi Telekomunikasi Indonesia —

BRTI), the Directorate of Telecommunication, the Directorate of Radio Frequency Spectrum Satellite Orbit, the Directorate of Post and Telecommunication Standardize, and the Directorate of International Post and Telecommunication Institutional.

BRTI is an independent regulatory body charged with protecting the public interest and fostering healthy competition in the telecommunications sector. It coordinates with Dirjen Postel and gives periodic reports to the Depkominfo.

The State Ministry of Research and Technology (Kementerian Negara Riset dan Teknologi — Ristek) is working on expanding the ICT infrastructure through telecommunications and Internet development, development of energy-saving and low-cost computers, and open source applications.

Private sector participation in ICT development in Indonesia is led by the non-profit Indonesia Infocomm Society (Masyarakat Telematika — MASTEL), which serves as a bridge between government and ICT industry groups. MASTEL has seven working groups: telecommunication blueprint, policy development, broadcasting, ICT roadmap, taxation, ICT for the rural areas, and dispute resolution.

The Indonesia Information Technology Federation (Federasi Teknologi Informasi Indonesia — FTII) is composed of associations in ICT-related fields with the common aim of promoting the growth of IT applications and the development of the IT industry.

The Indonesia ISP Association (APJII) seeks to develop the Internet in Indonesia. Its concerns include the management of the Indonesia-Network Information (ID-INC) and Indonesia Internet eXchange (IIX), and negotiating the telecommunication service infrastructure fee. APJII provides it members with Network Information Resources (NIR), gives advice to government, and organizes training programs.

The Indonesia Domain Name Registry (PANDI) was established in December 2006 to reduce Indonesia's dependence on overseas domains. Its duties include developing and providing services related with domain names.

The Indonesia Security Incident Response Team on Internet Infrastructure (ID-SIRTII) is responsible for the control of Internet traffic in the country. Its aim is to discourage and eliminate misuse and misapplication of Internet infrastructure particularly through cyber terrorism and Internet crimes like hacking. Its activities include collecting logs from ISPs, conducting traffic system analysis, and fostering collaboration for the protection of information security.

There are also civil society or consumer groups contributing to ICT development in Indonesia. One of these is Air Putih Foundation, a group of IT volunteers in Aceh providing ICT facilities and services in disaster areas since the Asian tsunami

in December 2005. The Indonesia Telecommunication Users Group (IDTUG, www.id.tug) was established in 2004 as a non-profit organization of companies, educational institutions, individuals, and other users of telecommunications services and infrastructure. The Center for ICT Studies Foundation (ICT Watch, www.ictwatch.com), a non-profit group established in 2004, focuses on ICT-related research and social programs. One of the latter is 'Internet Sehat', a campaign for the safe and responsible use of the Internet.

ICT AND ICT-RELATED INDUSTRIES

ICT Industries

According to the Department of Industry, Indonesia's ICT industries are distributed as follows: hardware, 5–10 percent; multimedia software, 30–40 percent; and consulting services, 50–65 percent. The value of the ICT market is estimated to be USD 979.9 million for hardware, USD 211.7 million for consulting services, and USD 110.3 million for software. In 2006–2007, the sector had an investment value of USD 54.7 million, a production value of IDR 40.3 quintillion, an export value of USD 2.8 million, and an import value of USD 2 million. The industry employs around 58,000–60,000 people.

To give ICT industries a boost, the Indonesian government has set up Regional IT Centers of Excellence (RICE) in 10 cities: Jakarta, Bogor, Cimahi, Bandung, Surabaya, Denpasar, Manado, Makassar, Balikpapan, and Medan. RICE management includes stakeholders from government, academia, and the business community.

Internet Service Providers

According to Dirjen Postel, as of the end of 2007 there were 298 licenced ISPs, 44 licenced Network Access Providers, and 25 multimedia companies. Of the total, only 202 companies have registered with the Indonesia APJII. Many APJII members are companies that need services such as IP address allocation and assistance in connecting to the IIX.

Internet Kiosks

The number of Internet kiosks, called *warnet* (for Warung Internet), is growing steadily. In 2007 there were more than 10,000 Internet kiosks, according to the Indonesian Internet Kiosk Association (Asosiasi Warnet Indonesia — AWARI). Many have been raided by the police for illegal use of proprietary software. Internet kiosks play an important role in providing Internet access in Indonesia, with 40 percent of the 20 million Internet users in Indonesia accessing the Internet from *warnet*.

On average, an Internet kiosk has 12 PCs, with each PC being used for up to seven hours per day. Users are charged IDR 4,000 per hour.

KEY ICT POLICIES AND PROGRAMS

In September 2007 the government declared PT Bakrie Telecom as the winner of the tender for international direct calls (Sambungan Langsung Internasional — SLI). In exchange for the exclusive right to run SLI services, PT Bakrie Telecom must build two international central gateways (Sentral Gerbang Internasional — SGI) in the west and east of Indonesia.

The Palapa Ring broadband fibre optic development is designed to connect all of Indonesia in one Internet infrastructure circle. This grand project consists of seven rings to cover 33 provinces and 460 regencies. The project has a budget of USD 255 million for laying 35,280 kilometres of submarine cable and 21,708 kilometres of land cable. Each ring will forward bandwidth frequency access from one point to another in every regency, providing a high-speed connection of 300–1,000 Gbps. The development is expected to take one year (all of 2009) and services will commence in the first quarter of 2010. In May 2007, a consortium of seven companies signed a memorandum of understanding with the government to undertake Palapa Ring Phase I, which will cover east Indonesia. The consortium was committed to deposit USD 11.2 million or 5 percent of the total project value.

At the end of 2007 Indonesia finally implemented the National Single Window (NSW) system in Tanjung Priok Harbor, Jakarta. With the NSW system applications for customs clearance and the necessary permits from the Food and Drugs Authority Agency (Badan Pengawas Pusat Obat dan Makanan), Directorate General of Overseas Trade (Dirjen Perdagangan Luar Negeri), Agriculture Quarantine Agency (Badan Karantina Pertanian), and Sea and Fish Quarantine Agency (Pusat Karantina Ikan) are made online at www.insw.go.id (see 'Clearing Customs in 30 Minutes Instead of 5.5 Days').

The USO program aims to build basic telephone infrastructure in 38,741 villages from a fund to which telecommunications operators shall contribute 0.75 percent of their annual gross revenue contribution. The program target is at least one phone line per village by 2010 and Internet access for at least 50 percent of the villages by 2015. In September 2007 the Indonesian government began to implement the USO program through a tender process that began with 23 companies expressing interest. Eleven companies actually made a tender and, after a thorough evaluation, two — PT Telkom and PT Asia Cellular Satellite — were declared as finalists. However, in December 2007 the USO tender was cancelled as the two finalists were found to be unable to meet the technical and administrative requirements.

Clearing Customs in 30 Minutes Instead of 5.5 Days

With the new National Single Window (NSW) system, getting customs clearance at Tanjung Priok Harbor has been reduced from 36 steps in the previous system to just five steps. The new system is also expected to eliminate opportunities for bribery (i.e. customs broker fees of as high as USD 100), which would reduce the cost of getting customs clearance to only about USD 11. The NSW will also reduce the time it takes to exit the harbor with customs clearance from 5.5 days to 30 minutes.

The NSW will also be implemented in Tanjung Perak — Surabaya Harbor, Tanjung Mas — Semarang Harbor, Belawan — Medan Harbor, and Soekarno Hatta International Airport. This is part of Indonesia's compliance with the ASEAN Single Window Agreement that seeks to establish a viable, simplified, standardized, and integrated environment for cargo clearance in line with international best practice as part of improving international trade in all ASEAN countries by 2015.

The government re-opened tender for the USO program in October 2008.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

In March 2008 Indonesia's House of Representatives passed the Electronic Information and Transaction Act, which covers information protection, certificates of authority, domain names, dispute resolution, and intellectual property rights. The law prohibits online pornography, gambling, slurs and defamatory attacks, and extortion and threats. It has provisions against misuse, hacking, and unauthorized system interception. The biggest penalty it imposes is about USD 1.3 million and/or 12 years imprisonment for falsification of electronic documents.

The law has received mixed reviews. Some sectors, in particular bloggers and members of the media, fear that the government could use the law to curtail freedom of expression and the right to information.

DIGITAL CONTENT INITIATIVES

The Indonesian Blogger Fiesta (Pesta Blogger) was held for the first time in December 2007 with about 500 bloggers in attendance. As of last count there were approximately 130,000 bloggers in Indonesia. Even the government ministers blog. Defence Minister Juwono Sudarsono (juwonosudarsono.com), Agriculture Minister Anton Apriyantono (apriyantono.com), Public Housing Minister Yusuf Asyari (yusufasyari.com), State Secretary Yusril Ihza Mahendra (yusril.ihzamahendra.com), and Forest Minister Malem Sambat Kaban (mskabanet.com) maintain blogs. Some politicians, artists, and members of the legislative and executive branches of government are also bloggers. Local blog sites such as www.blogdetik.com and www.

dagdigdug.com are well received as they are accessed much more quickly and do not involve overseas bandwidth use.

Online local news sites, such as Okezone.com, Inilah.com, Kompas.com, and Detik.com, are also experiencing significant growth. Detik.com marked its 10th anniversary in July 2008 with more than 500 million page views per month and over eight million unique visitors (based on IP addresses) per month. It is the most widely read local news website in Indonesia.[1] Detik.com has a mobile content service (mobile3845.com), and is now exploring Internet-based television content (tv.detik.com), a blog service (blogdetik.com), and a discussion forum service (detikforum.com).

In the education sector, some universities (e.g. Bina Nusantara University, www.binus.edu, and Pelita Harapan University, www.uph.edu) are using integrated learning management systems and offering lecture materials online. Moreover, Webometrics lists 17 Indonesian universities[2] among the top 5,000 in terms of Web presence. This means that these universities are accessible and visible through a university website, electronic publications, research activities, connectivity with the industrial world, and international activities.

The Department of Culture and Tourism (Departemen Kebudayaan dan Pariwisata — Depbudpar) has launched its official website (www.my-indonesia.info.id) to promote 'Visit Indonesia Year 2008' among overseas and domestic tourists.

ONLINE SERVICES

E-Banking is becoming popular among Indonesian Internet users with online services offered by some of Indonesia's most reputable banks like BCA Bank (www.klikbca.com), Mandiri Bank (www.bankmandiri.com), BNI 46 Bank (www.bni.co.id), and Lippo Bank (www.lippobank.co.id).

However, although there has been significant growth in cellphone use in Indonesia, mobile banking and mobile payments

have not followed suit. Some of the local banks, such as the BCA Bank and Mandiri Bank, are collaborating with mobile phone operators to provide mobile banking services. But at present most cellphone users in Indonesia are limiting themselves to voice calls and text messaging services. Telkomsel is promoting a mobile wallet service called T-Cash, which allows customers to use their cellphones to buy and pay for services online (through short message service — SMS) or offline (using a card to transact at participating stores).

e-Ticketing services are also common. Several local airlines — Lion Air (www.lionair.co.id), Mandala Airlines (www.mandalaair.com), Sriwijaya Air (www.sriwijayaair-online.com), and national flag carrier Garuda Indonesia (www.garuda-indonesia.com) — now issue e-tickets that can be reserved and bought online.

e-Commerce sites are increasing in number. Recently opened sites include computer and electronic sites (www.bhinneka.com and www.glodokshop.com), a community site for photographers (www.fotografer.net), online travel bureau (www.indo.com), gift shop (www.iyoushop.com), bookstore (www.kutukutubuku.com), and career sites (www.karir.com).

In addition, the first ever online wedding was held in Indonesia in 2006 (see 'Getting Married Online').

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

There are 476 universities in Indonesia offering ICT programs and 136 universities offering communication programs. Together they account for about 25,000 graduates annually. But this number is not sufficient to meet the demand in the local ICT industry. According to a study by the Center of Data and Analysis Tempo, IT graduates will be the most in demand among graduates in the next three years. About a thousand graduates will be completely absorbed by IT companies within a week at a starting salary of about USD 430 a month.

Meanwhile, the government is preparing all Echelon III and IV functionaries in every department/ministry to be their unit's chief information officer (CIO). In the future, the CIO will be positioned right under the minister or department head, and a CIO position will be introduced in the provincial government as well. A CIO is expected to develop and support the institution's e-government program, and justify the key performance indicator in the area to the National ICT Council. The CIO candidates will have three semesters of full-time study at the Gajah Mada University or Bandung Institute of Technology.

Two education networks have been established by the National Education Department (Departemen Pendidikan Nasional — Depdiknas) — JARDIKNAS, the National Education Network (Jaringan Pendidikan Nasional), and INHERENT, or the Indonesia Higher Education Network. JARDIKNAS is a network connecting over 3,000 educational institutions in Indonesia, whereas INHERENT is an inter-university network composed of 200 universities as of 2007.

The term JARDIKNAS was used for the first time in July 2006. The plan was to develop a national online network infrastructure for school zone interconnection needs in every city/region in Indonesia. The online network infrastructure would also connect to provincial offices of education as local nodes of JARDIKNAS. These provincial offices would then distribute

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Getting Married Online

Rita Sri Mutiara Dewi, a 50-year-old woman based in Bandung provine, and Wiriadi Sutrisno, a 52-year-old man based in the United States, held their wedding ceremony last 11 December 2006 via the Internet. Using video conferencing through VoIP, they were declared legally married by a Muslim leader.

Rita is a teacher in Malaysia. She went home to Bandung to get married, with her family and the Muslim leader in attendance. Wiriadi, who comes from North Sumatra, is a physiotherapist at a hospital in California, USA. During the wedding ceremony, Wiriadi was at his office with a friend who served as a witness. The couple, who had not met face-to-face prior to the wedding, met via a chat room. They conducted their courtship through photo exchanges and phone conversations.

The online wedding was declared legal by Muslim leader Penghulu, who noted that the requirement that the groom see his wife's face had been met. The wedding was made possible with the assistance of a technician from PT Telkom. Using a video screen and speakerphones, the couple pronounced their marriage vows (*Ijab Qabul*). The entire ceremony took 25 minutes and cost IDR 100,000. The plan was for Rita to go to California to finally meet her husband two weeks after their online wedding.

(Source: *Pasan gan Indonesia Nikah di Internet*)

JARDIKNAS to all schools, including the vocational school that functions as the ICT centre in each region. JARDIKNAS was officially announced by Indonesian President Susilo Bambang Yudhoyono at the opening of the Southeast Asian Ministers of Education Organization (SEAMEO) conference in Bali in March 2007. The announcement was witnessed in 34 other locations around Indonesia through the JARDIKNAS video conference system.

INHERENT was an initiative of the Directorate of Higher Education that began in 2006 with 83 universities connected to the network. The network used several technologies, such as fiber optics, microwave, wireless connection and satellite connection. The backbone capacity is 45 Mbps for the Java area, 8 Mbps for Sumatra, Kalimantan, Sulawesi, Bali, and Nusa Tenggara Island, and 2 Mbps for other islands like Maluku and Papua. The applications running on INHERENT include video conferencing, tele-teaching, remote learning, digital library network, telemedicine applications, grid computing infrastructure, and earth sciences applications (weather and climate prediction). The network is also a test bed for applications such as VoIP and Web caching.

In May 2007, the House of Representatives (Dewan Perwakilan Rakyat — DPR) evaluated the ICT program of the Department of National Education and recommended the integration of the management and infrastructure of JARDIKNAS and INHERENT to improve effectiveness and efficiency. Since August 2007 the integrated program has been known officially as JARDIKNAS. INHERENT infrastructure is now fully integrated as a component of JARDIKNAS serving the higher education zone. There are four network zones in JARDIKNAS: the education official office zone, the higher education zone (formerly INHERENT), the school zone, and the personal zone.

In 2007, the number of JARDIKNAS connections increased by more than 100 percent to 1,104 nodes. The greatest increase was in the higher education and government zones.

ICT RESEARCH AND DEVELOPMENT

Wajanbolic (*wajan* is the Javanese word for frying pan) is a parabolic antenna made from a frying pan. It was invented by Gunadi, who lives in Purworejo, Central Java. According to information from his blog, the wajanbolic technology allows access to a 2.4 GHz wireless Internet signal from a distance of 3–4 kilometres. In clear line of sight conditions, the signal has 60–70 percent stability and allows for Internet speeds of up to 54 Mbps. Each set costs about USD 41. Some private institutions, schools, and Internet kiosks are utilizing

the wajanbolic technology photos of which are available at the inventor's blog, http://gun001.multiply.com/photos.

Ristek's National Research Agenda 2006–2009 specifies the development of a food information system to facilitate bi-directional information flow for both fresh and processed food commodities between the food production and industry centre and the domestic or international market. The system is also designed to be used as a medium for providing the public with food-related information such as nutrition facts or suggested food processing methods. Investors can use the system to access information about the food production industry, such as the location, price, and production capacity for certain commodities. This system was designed to use various possible ICT tools like website or SMS so that it can be easily accessed by agro-business stakeholders and even by farmers.

Rural NGN (R-NGN) refers to research on Next Generation Network (NGN) technology applications for the countryside. It is expected to provide affordable Internet access as well as telephony service for people in the rural areas.

The digital broadcasting program was designed to provide better broadcast quality compared to traditional analog broadcast but at a relatively low cost, considering the economic condition of most Indonesians. Based on this reality, Ristek worked with research institutions from several universities to create some kind of inverter so that analog television (TV) can be used to receive digital broadcasts. In 2006–2007, this program carried out research and development (R&D) in packetized elementary streams (coding, compression, formatting) and stream multiplex and transport stream program. In 2007–2008, the research focus is on the RF/Transmission System (8-VSB modulation), the Cable Head-End (16-VSB) cable system, and the receiver and top box set (inverter for the analog TV). The program also involved the National Standard Board for the standardization, as well as state-owned enterprises and domestic industries to provide components and equipment.

OPEN SOURCE/OPEN CONTENT INITIATIVES

Ilmu Komputer.com or IKC (*Ilmu Komputer* means 'Computer Knowledge') is a website that contains free lectures, tutorials, translations, reviewers, and other materials about computer technology, delivered in Bahasa. Hundreds of volunteers from all over Indonesia and abroad contribute to the site, which received recognition at the World Summit on the Information Society (WSIS) as one of 'The 21 Continental Best Practice Examples in the Category e-Learning'.

In February 2007, Ristek announced that the ministry would provide a USD 5,300 technology assistance fund for small and medium enterprises willing to use open source software in running their business. In another move, the provinces of Nangroe Aceh Darussalam and Special Region of Yogyakarta announced in July 2007 plans to migrate to open source software, with the assistance of Air Putih Foundation.

The Indonesia Goes Open Source (IGOS) program was launched in 2004 to promote the development and use of open source software in the country. Penggerak Linux Indonesia Foundation, established in 1990, is also supporting open source software development and has developed BlankOn Linux Lontara, which uses Bahasa as the interface language. With the advocacy of these two groups, many local sites now use open source platforms.

VoIP Rakyat (Citizen VoIP, www.voiprakyat.or.id) uses an open source platform to provide VoIP services. The free service, which was developed by Anton Rahardja, has served more than 250,000 calls and has around 17,800 active accounts. It can be used to make cheap calls to fixed line and cellular phones. Thirty-year-old Anton has also created other open source programs such as SMS gateway PlaySMS (http://playsms.sourceforge. net), the Banjar bandwidth management software (http://banjar. sourceforge.net), and a Web-based billing software for Internet cafés called PlayBilling (http://playbilling.sourceforge.net).

CHALLENGES AND OPPORTUNITIES

According to Ristek, there are eight weakness that can slow down the growth of the ICT industry in Indonesia: *(i)* unfavourable business conditions due to weak law enforcement; *(ii)* relatively weak support for R&D and transfer of technology due to insufficient funding; *(iii)* lack of a national standard for ICT products; *(iv)* a limited export market; *(v)* high dependency on imported components and production equipment, resulting in vulnerability to global price changes; *(vi)* a limited number of professionals in ICT development; *(vii)* lack of optimal effort in developing ICT-based enterprise such as an animation industry; and *(viii)* software piracy. The latter cost the software industry a loss of USD 411 million in 2007.

In his note titled 'Strategy and Policy in Communication and ICT Development', the state minister of state-owned enterprise Indonesia, Sofyan Djalil (formerly the Minister of Communication and ICT), said that although Indonesia has the advantage of having a large number of demographic and geographic resources, having many islands could be an obstacle to ICT build-up and development. He recommended giving priority to ICT development in areas with high economic value, such as Java and parts of Sumatra.

In a presidential lecture held on 9 May 2008 with Microsoft Chairman Bill Gates in the audience, Indonesian President Susilo Bambang Yudhoyono noted that ICT can help resolve many of the country's problems, such as poverty, corruption, conflict, violence, deadly diseases, natural disasters, and mismanagement. However, although there are more and more computers in the districts and villages, few people understand how they can be harnessed to improve lives and foster development. The President underlined the fact that while there is a lot of useful know-how and creativity with ICT, these initiatives remain scattered and they are not being deployed in a coherent and even way to help the poor. Indeed, harnessing ICT for national development is the challenge confronting ICT advocates in Indonesia.

NOTES

1. Its sister sites include detikhot.com (celebrity news), detikinet.com (ICT news), detiksport.com (sports news), detikfinance.com (financial news), detikfood.com (culinary news), detikbandung.com (Bandung, capital city of West Java regional news), and detiksurabaya.com (Surabaya, capital city of East Java regional news).

2. The 17 universities include Gajah Mada University, Bandung Institute of Technology, University of Indonesia, Brawijaya University, Bogor Institute of Agriculture, Petra Christian University, 10 November Institute of Technology, Hassanudin University, STT Telkom, Airlangga University, Gunadarma University, Surabaya Electronics Polytechnics, Bina Nusantara University, Parahyangan Catholic University, Duta Wacana Christian University, Padjajaran University, and Lampung University.

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.ir

Iran

Masoud **Davarinejad** and Massood **Saffari**

Population	71,815,000ᵃ
Literacy (6 years old and older)	84.6% (male: 88.7%; female: 80.3%)
Area	1,648,000 sq km
GDP	USD 206.7 billion (current prices)
	USD 2,880 per capita
Unemployment rate	11.0ᵇ
Inflation rate	17.6ᵇ
Computers per 100 inhabitants	7.8 per 100 inhabitantsᶜ
Fixed-line telephones	23,484,000 lines (33.0 per 100 inhabitants)
Mobile phone subscribers	26,355,000 subscribers
	(36.7 per 100 inhabitants)
Internet users	11.5 million subscribers
	(16.0 per 100 inhabitants)
Domain names registered under .ir	72,330
Broadband subscribers	350,000 subscribers (0.49 per 100 inhabitants)
Internet domestic bandwidth	20,180 Mbps (est.)
Internet international bandwidth	9,626 Mbpsᵉ (December 2007)
e-Readiness overall score	3.08ᵈ

(Sources: ᵃStatistical Center of Iran 2006; ᵇCentral Bank of Iran 2006; ᶜComputer Guild Organization 2006; ᵈEconomist Intelligence Unit 2007)

Notes: ᵉAcademics and independent research groups dispute this figure. They estimate a minimum inflation rate of 20.7 percent and an unemployment rate of 15.4 percent (Sarmayeh 2007).
ᵉConsultant groups and independent sources have estimated this to be not more than 5,500 Mbps.

OVERVIEW

Information and communication technology (ICT) accounts for 1.1 percent of Iran's Gross National Product (GNP), which suggests that it plays a minor role in the country's economy. In 2007, there were many challenges to ICT as an enabler of economic and social development. High inflation rates, officially pegged at 16.7, but widely mistrusted as being skewed due to the downplaying of skyrocketing housing costs, adversely affected new investments and raised production costs. Although Iran's new president, in office since June 2005, is popular among the masses in the Middle East and parts of Asia, he has incurred the ire of world leaders for his insistence on Iran's right to develop nuclear capabilities. Unfair economic sanctions against Iran spearheaded by the United States (US) and its European allies, although constantly mocked as ineffective by Iranian leaders, are crippling Iran's banking system and blocking the flow of technology and foreign investment.

A motion to eliminate numerous overlapping councils and organizations governing ICT affairs has been praised as necessary to boost government performance. Unfortunately, this belated motion has boomeranged as no credible study was made to formulate the country's roadmap to success.

E-Banking gained momentum in 2007 and an inter-banking network named Shetab, controlled indirectly by the Central Bank, handled 47.7 million[1] transactions on average per month. This represents a huge increase from the 25.9 million transactions of the previous year. Internet banking reached 0.093 million transactions per month or 0.25 percent of the total, which is an indication of the potential for growth.

The number of mobile subscribers reached 26.3 million in 2007, representing a penetration rate of 37 percent, while the

number of Internet users grew to 12 million, also a remarkable increase. However, Asymmetric Digital Subscriber Line (ADSL) private licencees have expressed concern regarding the growth of the government-owned company competing in an unfair manner and complained about increasing difficulties in gaining access to infrastructure. In mid-2007 the third mobile operator licence first conceived in 2004 in the process of opening up mobile telephony to competition gained momentum and attracted investors to assess the market.

The Fuel Smart Card project (FSC) was implemented on a national scale in 2007. More than 10 million automobiles and three million motorcycles were issued an FSC to use in 2,300 fuel stations all over the country basically to prevent the illegal sale of gasoline sold at USD 0.1 per litre to neighbouring countries.

TECHNOLOGY INFRASTRUCTURE[2]

In 2007 the Telecommunications Company of Iran (TCI) remained the sole operator of fixed telephony nationwide. Although five regional fixed line operators were granted regional licences in 2001, they have remained minor players. The TCI provided close to 10 million fixed lines (14.9 penetration rate) prior to 2000. This figure reached 21 million at the end of 2006 and 23.4 million (33.2 of 100 inhabitants) at the end of 2007.

The number of mobile phone subscribers grew to 26.3 million in 2007, representing a 130 percent increase from the previous year's total and a penetration rate of 36.7 percent. The growth is due mainly to the competition introduced by the second mobile operator, which commenced operations in 2006 and

accounted for a third of the total subscribers in 2007. A major development has been the marketing of prepaid SIM cards by the second mobile operator for an initial fee of USD 50, which was later reduced to USD 15. This is far more attractive to consumers than the USD 400 official price offered on a limited basis by the first operator for its postpaid service.

The packet switching data network based on x.25 introduced in 1994 has legacy subscribers mainly in government agencies and the airline and banking industries. The number of transmission circuits in 2007 reached 1.69 million.

The fibre optics network reached up to 375,000 kilometres by the end of 2007. However, the deployment of fibre optics in other infrastructure sectors, such as Iran Railways and Iran Power Generation, Transmission and Distribution Company (TAVANIR, http://www.tavanir.org), remains unchanged.

In 2005 the Communications Regulatory Authority (CRA, http://www.cra.ir) opened satellite services to competition, targeting the issuance of five licences over a period of five years. Including the capacity created by TCI and the central bank, a total of 5,500 very small aperture terminals (VSAT) were in operation as of the end of 2007.

Among the services opened for licencing to the private sector were data communications service provider licences (known as PAP for 'Public Access Providers' in the Persian language). At the end of 2007 there were 11 private broadband operators in the market providing ADSL, XDSL, G.HSDSL, and wireless services such as Worldwide Interoperability for Microwave Access (WiMAX) to about 350,000 subscribers in more than 40 cities. Surprisingly, and supposedly to uphold standards of decency by preventing the downloading of unsuitable images and clips, the Ministry of Communications and Information Technology (MCIT, http://www.ict.gov.ir/) has banned Internet connection speeds higher than 128 Kbps to homes. The decree, which was made public in 2006, was heavily criticized, and it has hampered the growth of ADSL in Iran.

The number of Internet service providers (ISPs) remained steady at 747 as there was no policy to issue new permits. The same is true of the number of Internet connection providers (ICPs), which remained at 35 at the end of 2007.

In 2007 the Institute for Research in Fundamental Sciences (Institute for Research in Theoretical Physics and Mathematics — IPM, http://www.ipm.ac.ir) continued to preside over and manage the .ir top level domain. IPM started providing domain names in the Persian language in 2006. As of the end of 2007, in addition to the 72,330.ir domain names, there were also 4,300 Persian domains registered.

The number of Internet users is still a source of debate. The figure announced by the MCIT and its affiliates is 11.5 million, or 16.5 for every 100 inhabitants in 2007, which indicates a 50 percent increase from the previous year. Independent sources are questioning the MCIT figure.

KEY INSTITUTIONS DEALING WITH ICT

The High Council of Informatics (HCI), composed of representatives of several key ministries and organizations, was the first body empowered by the Council of the Islamic Revolution to address and make decisions on computer-related issues in Iran. Its major activities in the first few years following its establishment in 1979 were to manage and settle claims and disputes with large international computer companies departing Iran at will. In 2001, the High Council of Information Dissemination (HCID), with its initiative called TAKFA (an acronym in Persian that stands for 'Development of Information Technology Applications'), began to take over policymaking in information technology (IT), and the role of HCI as the policymaker gradually faded away.

In 2003, a law specifying the duties and powers of the MCIT was passed and the Supreme Council of Information Technology (SCIT, http://www.shci.ir/) was born. The law sought to:

1. Expand the duties of the new ministry from telecommunications and management of the radio frequencies to formulating strategies and the national IT plan and policies for the dissemination and implementation of information technology in social, economic, and cultural arenas nationwide; and

2. Establish a regulatory body to implement approved policies to restructure the telecommunication sector and allocate and monitor the frequency spectrum.

However, the new legislation fell short of dissolving outdated, ineffective, and redundant government bodies. Although the new SCIT, chaired by the president and managed by the MCIT, has taken over all aspects of ICT, overseeing digital content development remains the responsibility of the HCID.

Thus, the official policymakers in ICT in Iran are the MCIT, HCI, which is affiliated with the Management and Planning Organization, SCIT, and HCID, which is affiliated with the High Council of Cultural Revolution.

As part of a radical policy of downsizing, the President issued a decree in mid-2007 to dissolve or merge numerous councils with overlapping mandates. The decree included the merger into one council of most of the above-mentioned ICT-related councils. Unfortunately, the policy has backfired as no credible study was undertaken to design the roadmap to success.

Moreover, the parliament immediately expressed its disapproval, arguing that the move requires legislation that should be approved by the parliament. With the parliament discrediting the President's move to restructure the bureaucracy, legal entities dealing with ICT have been left in disarray and no one is being held to account for various negative developments. In late 2007 the parliament finally passed a law enabling the government to pursue a limited restructuring effort, but this law is pending approval by the Guardian Council.

In addition to the official bodies, the High Council of Cyberspace Information Exchange Security (AFTA, http://www.afta.ir/), which is affiliated with the President's office, has assumed responsibility for security issues among government organizations. Other government-affiliated supporting bodies or organizations involved with ICT developments are:

- The Hi-Tech Industries Center (http://www.hitech.ir/) affiliated with the Ministry of Industries and Mines.
- The Electronics Fund for Research and Development (http://www.esfrd.ir/) also affiliated with the Industries and Mines.
- TASMA (Production and Management of Electronic Content, http://www.scict.ir), an initiative to complement TAKFA started in early 2006 under HCID.

Several non-government organizations (NGOs), some of which have been active for more than a decade in Iran, are active in the ICT sector. They are the Computer Guild Organization, Iran Informatics Companies Association, Sanaray Software Export Research & Development (http://www.sanaray.com/english/Site.aspx), Informatics Society of Iran (http://www.isi.org.ir), Computer Society of Iran (http://www.csi.org.ir), and the Union of Iranian Software Exporters (http://www.uiseonline.org).

ICT AND ICT-RELATED INDUSTRIES

The opening up of the telecommunications market at the end of the 3rd Five Year Development Plan (2000–2004) created an opportunity for small and medium-sized companies in electronic industries and encouraged new companies to join the bandwagon. Each of these companies created 300–2,500 jobs. In 2002, 22 new general contractor (GC) companies were registered and won contracts to install new Base Transceiver Stations (BTS) in the 1800 MHz band and widen coverage in the 900 MHz band. It was also during the 3rd Five Year Development Plan that the government privatized major government IT companies and reduced the involvement of such companies in major IT contracts.

However, the past three years until 2007 have seen a reversal of the policy, with major IT contracts being awarded to companies affiliated or associated with the government. This has resulted in a number of Iranian IT companies and professionals abandoning business in Iran to start afresh in Canada or the United Arab Emirates. Over the past decade, the migration of technical capacities from Iran has been fluctuating, with some reversal noted in 2003–2005. But the new wave of migration could prove detrimental to the growth of Iran's IT industry and the economy as a whole.

While the production of telecommunications switches, fibre optic and copper cables, Liquid Crystal Display (LCD) TV and monitors, Global System for Mobile-Base Transceiver Station (GSM-BTS), antenna, power supplies, and the like did not expand in 2007, negative indicators have been noted in the same period, such as a reduction in the number of companies registered with the SHCI from 993 in November 2004 to 798 in 2007. Membership in the Computer Guild Organization declined to 650 in 2007. Moreover, ICT fairs, exhibitions, and events in 2006–2007 were smaller and had fewer visitors than in previous years, another indicator of the decline of ICT companies and business activities and of the need to revitalize the market.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Privatization was the main theme of ICT development during the 3rd Five Year Development Plan. Articles 24 and 128 of the Plan outline a framework for the development of the telecommunications sector based on three distinct and well-designed strategies:

1. Require the incumbent operator to extend coverage, diversify quality services, and boost performance by outsourcing its major activities and new developments of the network to qualified private sector companies.
2. Issue licences to the private sector to provide fixed-line telephony, cellular or mobile telephony, broadband data communications, and wireless services.
3. Establish a credible regulatory authority to implement the strategies and policies and guide the private sector to reach the milestones specified in the Development Plan.

The 4th Five Year Development Plan, covering 2005–2009, envisions the creation of a knowledge-based economy through:

1. Systematic expansion of ICT application consistent with national development goals.

2. Development of human resources as a strategic priority in the expansion of ICT application to create more 'value creating' jobs.

3. Cultural development and creation of an empowering environment for creating maximum national synergy.

4. Implementing the necessary infrastructure for development of ICT, including access network, security, laws and regulations, resources, and facilities.

5. Development of facilities and opportunities toward mobilization of the private sector.

The Plan also exempts technology parks from state and local taxes, on top of a number of other incentives, as a strategy to attract investors.

The Telecommunications Regulatory Organization was established in 2003 and the framework for granting the licences for fixed line telephony, mobile services, data communications, satellite communications, and Voice over IP (VoIP) was approved by the Communication Regulatory Commission. Between 2003 and 2005 all licences except those for VoIP were granted to qualified applicants.

TCI, which was established in 1963, was broken up in 2005 into four new companies in line with principles stipulated in the 3rd Development Plan. The four new companies are:

- Telecommunications Infrastructure Company (TIC), to concentrate on infrastructure maintenance as well as the development of new infrastructure, including the fibre and copper cable inter-province network and switches, microwave network, satellite earth stations, and international switching and calls.

- Mobile Communications of Iran Company (MCI), the state operator for mobile telephones and the country's first mobile services operator.

- Information Technology Company (ITC, http://www.itc.ir), the state operator for broadband and international data communications facilities such as X.25 and gateways to the Internet and provider of access to major government users.

- The legacy TCI that now acts as a holding company managing baby TCIs and owns the provincial TCIs that are actually the provincial fixed-line operators with right-of-way benefits granted by law. The network of copper cables and wires to subscribers, distribution frames and posts is an asset worth billions of dollars that has been given to TCI for its development.

A report prepared in 2007 by the MCIT in response to criticisms about its anti-privatization moves indicates that the new TCI Company and all provincial companies shall be privatized.

However, analysts and consultants have criticized the plan as being anti-competition. This is because once it is sold for the best price, the last mile copper network could end up in the hands of one of the private sector operators, which in effect would be a monopoly albeit wearing a different façade.

With regard to public key infrastructure, the Root Certificate Authority and the second layer certificate authority were established in 2007.

To promote ICT projects by the private sector, the government grants low-rate loans through several agencies. One of these is the ESFRD, which was established in 1997–1998 with a total paid-in capital of USD 37 million. Its objectives are to promote entrepreneurship, software development, engineering services, international collaboration, and export. The ESFRD assists non-government ICT projects by extending inexpensive loans, issuing guaranties, and providing information services, and soon by means of venture capital investment. However, due to shortages in capital funds while lowering the interest rates for loans, the ESFRD now lacks financial resources to fulfil its mission.

The Ministry of Labor and Social Affairs (MLSA) also grants medium-term business and self-employment loans to small businesses. In 2006 and 2007, following the populism advocated by the government, the MSLA announced unlimited low-rate loans for rapid return investments and flooded the market with cash. The result is that the loans, which are spread over many sectors, have brought a huge amount of cash liquidity to the market with inflationary effects. Moreover, the loans have had little impact on the growth of the ICT sector as they have not been allocated to ICT projects.

In e-government, TAKFA was an initiative by the President's special envoy and an instrument of the secretariat of the HCID in 2001–2004 primarily to assist ministries and other government agencies in the pursuit of their ICT development goals and projects. It encouraged government bureaus to explore how ICT can help them accomplish their mission, and it provided funding support for the integration of ICT into bureau operations. The initiative devised 110 major projects consisting of more than 5,000 sub-projects in almost all sectors.

However, there was no coordination between TAKFA and the HCI. Moreover, without a coherent vision and solid strategies, TAKFA initiated hundreds of open-ended projects. There were no specific selection criteria and no plan for monitoring and assessing project outcomes. TAKFA was also heedless of the capacity required for ICT development. In 2005, TAKFA faced numerous obstacles on its oblique course and, unable to establish any form of organization to be able to move forward, it perished in late 2005.

TASMA emerged in early 2006 and was nicknamed TAKFA2, although it is not a sequel to TAKFA. TASMA has seven areas of focus:

- e-Government
- Education and development of digital skills
- Higher education, health, and medical therapy and training
- Social services
- Commerce and trade
- Culture, arts, and Persian language and script in the computer environment
- ICT industry through small and medium-sized enterprises (SMEs) empowerment, incubation centres, and technology parks

However, TASMA's ability to produce results is being questioned because there is no government recognition of and commitment to the role of ICT in development. Moreover, a parallel effort is in progress within the MCIT.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The telecommunication regulatory authority was established in December 2003 following a comprehensive study conducted for the Ministry of Post, Telegraph and Telephone (MPTT, now the MCIT), in collaboration with the Management and Planning Organization and with assistance from the ITU. Among the study's recommendations, which was based on international practice and which stakeholders in the ICT sector unanimously adopted, was the establishment of an independent regulatory authority prior to or alongside the privatization and opening up of Iran's ICT market. It was believed that an independent regulatory authority, backed by the MCIT, would succeed in getting TCI to comply with the requirements of privatization.

The regulatory authority was designed to have a board or commission with the power to approve regulations for the shaping of the telecommunications market, and an executive body or organization to implement the regulations approved by law or by the commission, control and audit the service providers, and assess the outcomes of policies implemented. The first was the Communications Regulatory Commission, consisting of five members and headed by the MCIT minister. The second was called the Communications Regulatory Organization and was headed by the deputy minister of the MCIT.

The appointment of the head of the regulatory authority and the pivotal role of the minister in the commission was criticized from the outset as a design flaw that could undermine the

regulator's credibility. But the counter-argument was that the new regulatory authority would not survive without the protection of the minister of the MCIT who has full control of the incumbent operator and that anything less, at least for the duration of the five-year plan, would result in the failure of privatization. It was noted that a controlled approach to deregulation and the opening up of the market is imperative in an environment that is fully managed by the government and characterized by a frail private sector consisting of small and medium-sized companies. It was also argued that getting the incumbent operator (TCI) to share the infrastructure impartially with other operators would require the intervention of the minister who alone had the necessary legal power to push for such objectives.

However, the expected removal of TCI's monopoly status has in fact not taken place. The second mobile operator has complained about TCI's shortcomings in providing access to the telecommunications infrastructure and about being pressured to comply with TCI's pricing scheme. Now, independent analysts believe that to achieve the objectives set forth in the 4th Development Plan, it is time to press for a regulatory agency that is independent of the MCIT.

As one of the conditions for the licencing of the second mobile operator, the regulatory authority pledged not to issue a third licence for mobile services until two years after the licence of the second operator had been issued. The deadline has passed and the MCIT has announced its decision to kick off the licensing process before June 2008. However, no official specifications and information on the process have been released to date.

In late 2004, 11 licences were issued to provide the public with wired and wireless data communications services. The licencees, known as PAP operators in the local market, could provide any type of connection, such as ADSL, WiMAX, G.HSDHL, and other high-speed services, to upto 350,000 subscribers in more than 40 cities. However, beginning 2005, the PAP providers have expressed grave dissatisfaction with the regulatory authority and the MCIT, pointing to pressure from the incumbent operator for them to leave the market to government-owned and operated companies (see 'PAP Operators Denied Access to the Last Mile').

Another key initiative is the proposed legislation on freedom of information. The need for such legislation was first cited in 1995 by the HCI secretariat as part of its focus on legal aspects of ICT. Following scattered studies and a review of the literature over seven years and three years of work on the draft, the proposed act finally reached the parliament in 2005 for approval. The act, which aims to facilitate access for individuals to government and other public information, is expected to be signed into law within 2008.

PAP Operators Denied Access to the Last Mile

The licences granted to 11 PAP operators were affixed to a set of commitments signed by the regulator and the MCIT minister. It specifies that they have the right to access the cable distribution frames and copper lines to subscribers that they specify. The provisioning of space and other telecommunications facilities belonging to TCI was promised on the condition that such facilities do exist at the centres or nearby buildings.

But a report issued by the PAP operators claims that on many occasions and in more than half of the telecommunications centres where the facilities are available, they were denied the service and their complaints to the regulator and the minister have not been acted upon. Moreover, in 2007 the PAP operators were encouraged by the MCIT to dissolve and become a partner to provincial TCIs. In return, the MCIT would outsource all existing and future ADSL development to them. Although the MCIT plan did not materialize and the PAP licencees rejected it, the PAP operators cite it as evidence of the MCIT's backtracking on privatization and they blame this for rumours of a sell-out to TCI by some PAP operators.

(Source: *Communication World* 2005)

DIGITAL CONTENT INITIATIVES

The growth of Internet usage in Iran is being driven by people's need to express ideas and circulate news and information where ordinary means are not adequate or are expensive or where there are political and social controls and blockages. Newspapers, social organizations, and NGOs are using the Internet to spread their ideas, recruit members, and stay in touch with their members. There are numerous blogs and mailing lists that are attracting more and more users by the day. The number of Persian blogs is estimated to be around 800,000. About an eighth of these is registered with service providers like Persian Blog (http://www.persianblog.com) and Blogfa (http://www.blogfa.com) and actively engaged in producing content. Other sources have reported the number of active blogs to be around 200,000, representing a 30 percent increase from the previous year's total.

Tebyan (www.tebyan.net) is a Web portal established in 2000 and affiliated with the Islamic Development Organization. It has generated about 350 Gb of cultural and Islamic content, mostly for the youth, and it has about 300,000 visitors a day. Tebyan also owns 30 ISPs in all states, which provide access to the portal.

TASMA was launched by the HCID in 2006 to promote digital content. The program is part of a restructuring plan that led the HCID to focus exclusively on Persian content and leave other aspects of ICT development to the SCIT. In 2007 TASMA organized an exhibition intended to introduce the main issues in content development and solicit support from the government. Unfortunately, the exhibition was not well attended.

Religious institutes capitalizing on public funds and donations have concentrated on digitizing old documents and inscriptions, some dating back to 1,200 years ago. These are available for a minimum charge in digital versatile disc (DVD) format.

ONLINE SERVICES

The number of e-government services in Iran is very low compared to that in many countries in the Middle East. But the existing online services are now more diversified and are enjoying wide patronage.

In 2007, probably a turning point in the number and magnitude of e-government projects, one project attracted the most attention from the government and the parliament and it had a major impact on everyday life in Iran. This was the Fuel Smart Card project (see 'The Fuel Smart Card Project').

e-Banking and Inter-Banking

Also in 2007 e-banking gained momentum with all public and private banks joining Shetab, an inter-banking system controlled indirectly by the Central Bank. The implementation of a real-time interbank gross settlement system (RTGS) is also in progress. Shetab handled 47.7 million[3] transactions per month in 2007, which represents a huge increase from the 25.9 million transactions of the previous year. Internet banking accounted for 0.093 million transactions per month, or 0.25 percent of the total.

The Fuel Smart Card Project

The Fuel Smart Card project (FSC) was probably the single most important ICT project in Iran in 2007. The project had been proposed by previous governments but it was never implemented due to public resistance to rationing systems, as the latter call to mind bitter memories of the eight-year war with Iraq. The project was finally implemented in 2007 on a national scale, at a cost of USD 130 million. About 15 million cards were issued (of which one million were replacements for lost, stolen, and burnt cards). More than 10 million automobiles and three million motorcycles were issued the FSCs with specific gas quotas to use in 2,300 fuel stations covering 28,000 pumps all over the country.

Because the FSC is considered a mission-critical project by the government, the designers had to consider both online (priority) and off-line situations. Gas stations are grouped by regions, with local database servers in the regional bases and gas stations. These regional and local databases are updated by the central system a few times each day in order to be able to handle off-line incidents. The database system is reported to be available 96 percent of the time.

The FSC is capable of supporting e-purse transactions and it can connect to the Shetab gateway to handle gas payments and similar transactions. However, although this aspect of the project has been successfully piloted, no instruction for its regular implementation has been given.

The FSC project could also help the police department to complete its vehicle identification database, where many similar previous attempts have failed.

The project's next step will be the inclusion of gasoil used by trucks and buses in the rationing plan and use of the FSC infrastructure to implement rationing objectives. One of the main goals of the FSC project was to enforce a diversified rationing plan based on application and vehicle specifications, and control the black market and smuggling of USD 0.1 per litre gasoline to neighbouring countries. It was reported that during a three-month period, a total of 2,300 million litres of gas was saved from illegal business at the borders, resulting in savings of USD 920 million.

The experience gained by Iran Telecommunication Industries Co. (ITI) during the successful implementation of the FSC project has qualified the company to win a similar project in Syria.

(Source: Ghaemian 2008)

Online Registration for University Admissions

Every year millions of high school graduates compete for limited places at prestigious universities and colleges. The process involves obtaining registration forms, paying the requisite fees, shipping the documents, and receiving the registration number that the applicant must present at the testing centre as proof of registration and payment. The process was widely considered to be tedious, time-consuming, and highly stressful given the grave consequences for the future of the applicants of a failure of postal services. In 2007, after a few years of trials in small colleges, the entire process was conducted online for 850,000 students nationwide.

Besides the burden inflicted on the applicants in the past, the ISPs had their own share of headaches when millions of registered applicants and their families used the Internet to access the few sites that published the examination results. Now the new online registration system allows the applicants and their families access to examination results without too much hassle.

Online Registration of Candidates for Parliamentary Elections

Much less complicated (compared to online registration for admission to university) was the online registration of candidates in the parliamentary elections in March 2008. The anticipated number of candidates was less than 10,000 nationwide and the online service included the registration and notification of candidates of the status of their registration. The Ministry of Interior had proposed the project some years back but because of lack of trust in the supervising authorities, conservative chiefs and trusted merchants unfamiliar with and partly frightened by the stories of security flaws and technical glitches refused to give the administration a chance — until 2007 — to show them the benefits of e-government.

Other Online Services

Payment of bills for electricity, telephone, mobile phone, gas and water services using ATM machines, websites, and telephone

banking facilities was implemented in Iran in 2007. Currently under study are an e-passport system, online visa application and processing, and an online vehicle identification system using radio-frequency identification or RFID.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

IT and computer engineering programs are widely offered in Iranian universities and other higher education institutes. Together these programs had an intake of 95,800 in 2007, which represents an 80 percent annual increase over the last two years. In 2007 the total number of students in computer and IT programs at major government (public) universities, without taking into account Payame Noor University (a distance learning public university) and Azad University (a non-government public university), was 108,700 students, of which 49 percent were female. Of the total, 45.5 percent were enrolled in post-diploma programs, 52.8 percent were in Bachelor's programs, and 1.7 percent were in Master's and doctoral programs. About 60 percent of the postgraduate programs in IT are offered in government (public) universities, and majority (62 percent) of the students pursuing a Bachelor's degree were enrolled in Payame Noor University.

The number of graduates in fields directly related to IT is estimated to be about 20,000 per year, which far exceeds the number of job vacancies. The IT industries have criticized universities for not responding to the market's need for more diversified and multidisciplinary programs and graduates.

The influx of students to the universities is putting a severe strain on faculty resources, which in turn is preventing faculty members from pursuing research and post-doctoral activities and new course designs. The decision of the government universities to offer more postgraduate programs (even a post PhD) is exacerbating the problem.

A total of 4,108 high schools was reported to have access to the Internet using DSL by the end of 2007. This number had increased to 5,813 high schools by April 2008.

As part of an agenda to promote entrepreneurship, the MLSA is pushing for vocational and postgraduate training to help entrepreneurs understand business and investment needs, and to make job seekers qualified for the market.

ICT RESEARCH AND DEVELOPMENT

The Iran Telecommunications Research Center (ITRC, http://www.itrc.ac.ir/en.php) was established in 1970 by the University of Tehran and the Government of Japan (NTT) to conduct research on telecommunications issues. The ITRC later became TCI's research centre. In 2005 the ITRC's mandate was expanded to cover research on a national scale and not just research related to TCI. The ITRC is fully supported by the MCIT and the head of the organization is directly appointed by the MCIT minister.

In 2006–2007 the ITRC went through a shakedown, including a redefinition of its goals and missions. However, the restructuring fell short of setting clear objectives and left unresolved the matter of whether the ITRC would become a private or a government entity. As a result, many ongoing projects came to halt and team members were laid off.

In 2007 the ITRC outsourced about USD 50 million of its research and development (R&D) projects to the universities. Its 2008 target is to outsource about USD 120 million of its R&D projects. A notable ITRC project was preparing the bidding documents for the third mobile operator to be managed by the regulatory authority. There are also pilot projects in New Generation Network (NGN), third generation (3G) network, WiMAX, and intelligent processing of medical information. In late 2007, the ITRC announced a new list of research priorities ranging from infrastructure to policymaking.

CHALLENGES AND OPPORTUNITIES

The ICT sector in Iran faces a number of important challenges. First, conditions prevailing since 2006 have not been in favour of an open market and privatization, and recent ambiguous pronouncements by the MCIT and other authorities indicate that this trend is continuing. Mounting pressure from TCI on PAP operators, which is intended to re-monopolize the broadband market, and on other mobile operators to follow pricing schemes that are incompatible with the principles of competition, are a testimony to the fact that the regulatory body has lost its credibility to some extent. For this reason, the principles of regulatory independence and impartiality now need to be reaffirmed and heeded.

Second, the regulatory authority needs to take a stronger position in favour of competition in the ICT market and against monopolistic moves. A particular area of concern is the granting of VoIP licences, which is being derailed by the incumbent's move to maintain its monopoly over international calls. In 2004, the MPTT (now MCIT) prepared a temporary (renewable annually) permit to regulate the growing market in international calls. The permit covered only international calls originating from Iran and declared terminating calls as illegal.

One year later, a full VoIP licence was drafted, finalized and approved by the Communications Regulatory Commission. The draft licence, which was based on a comprehensive model named 'international voice services', covered both origination and terminating calls, as well as transit calls, and could have eliminated the gray market operated by unlicenced companies. Unfortunately, the new VoIP licence was never issued due to a renewed claim by TCI that it has the monopoly over international calls by virtue of a 1965 government mandate. In its argument, TCI capitalized on the issue of security and centralized control, which has become a popular theme in the region.

Finally, the concerned government agencies should aim to foster the growth of mobile services in Iran. There has been rapid growth in mobile services in the region and in Iran's neighbouring countries, with some of the latter achieving a penetration rate of more than 100 percent, compared to just 41 percent in Iran. This underlines the need to explore the opportunity and potential for mobile telephony in Iran.

NOTES

1. All figures pertaining to the banking system are drawn from the Banks IT Commission, January 2008.
2. All figures in this section are from the 2007 Iran telecommunications indicators compiled by the Telecommunications Company of Iran.
3. All figures pertaining to the banking system are drawn from the Banks IT Commission, January 2008.

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Japan

Keisuke **Kamimura** and Adam **Peake**

Population	127.76 million[a]
GDP per capita (PPP)	USD 34,312[b]
Key economic sectors	ICT, construction, wholesale, manufacturing[c]
Computers per 100 inhabitants	54.15[d]
Fixed-line telephone per 100 inhabitants	37.7[e]
Mobile phone subscribers per 100 inhabitants	76.8[e]
Internet users per 100 inhabitants	68.5[e]
Domain names registered under .jp	1,012,199[f]
Broadband penetration rate per 100 inhabitants	20.70[e]
Internet domestic bandwidth	812.9 Gbps (monthly average)[g]
Internet international bandwidth	81.3 Gbps (monthly average)[g]

(Sources: [a]IPSS 2006; [b]IMF 2008; [c]MIC 2007b; [d]ITU 2007; [e]MIC 2007c; [f]JPRS 2008; [g]MIC 2008e)

INTRODUCTION

A generation of Japanese has grown up with the understanding that they live in the world's second largest economy, and this ranking has become a brand, both domestically and internationally, representing Japan as a powerhouse of manufacturing and leadership in high technology. But the rank is under threat. Already by some measures China has jumped ahead. For example, China is now second to the United States (US) in purchasing power parity. Although Japan still leads in the more useful measure of real Gross Domestic Product (GDP), economic forecasts show Japan falling behind China by 2020 and India soon after, with Brazil catching up by the middle of the century (Goldman Sachs 2007).

Indicators of the health of the economy, such as the Tankan (Short-period Economy Observation), a poll of leading Japanese firms conducted quarterly by the Bank of Japan to track business confidence, have been negative. The most recent cabinet office survey of the economy show recent improvements in corporate profits and employment to be slowing, and business investment declining moderately. A concern for the information and communication technology (ICT) sector in particular is that private consumption is almost flat. It would appear that Japan's economy is mirroring that of the US by entering a recessionary phase.

However, for now Japan remains among the ICT leaders in the Asia Pacific region and in many areas is a global trendsetter for advanced use of consumer ICT devices and services. Broadband services in Japan remain the cheapest and the fastest in the world[1] (OECD 2007), and while mobile telephone services in Japan are not cheap, mobile devices and services are sophisticated and continue to evolve at a rapid pace as operators try to capture revenue in a very saturated and competitive market (Hall 2007).

Over 42 percent of Japan's real GDP growth is driven by growth from the ICT sector. The sector is expected to retain this important position in the economy as current trends continue, new products emerge around media convergence, and further reform of the telecommunications sector is implemented. With recent developments such as the unification of the future digital versatile disc (DVD) storage market behind the Blu-Ray standard, a new generation of super-slim flat panel displays, and increased service competition on wireline and wireless broadband, the outlook for the ICT (digital) sector is positive.

TECHNOLOGY INFRASTRUCTURE

The number of competitive telecommunications carriers has increased dramatically since competition was introduced in 1984, with 14,449 such companies in August 2007 from 87 in April 1985. However, while competition in the overall market has been increasing, at the end of March 2007 the two Nippon Telegraph and Telephone (NTT) regional companies, NTT East and NTT West, still owned 93 percent of all access lines. At the end of December 2007 NTT East and NTT West controlled 87.2 percent of contracts for subscriber telephones, indicating a drop of 0.7 percent from the previous quarter (MIC 2008a). Although NTT's market share is decreasing as more subscribers switch to IP telephony service provided by competitive carriers, after more than two decades of competition NTT remains dominant in the local access market.

As of December 2007 there were 28.3 million broadband subscribers in Japan, approximately 58 percent of the country's 49 million households. From October to December 2007, 555,593 new subscribers took up broadband services. This is a marked slow-down in growth rate compared to the boom days of broadband in Japan when for a seven-month period between November 2002 and May 2003 subscribers increased by more than 500,000 each month. However, the overall market continues to grow and a projection of subscriber growth trends from 2007 suggests that fibre-to-the-home (FTTH) is becoming the most common form of broadband access. The decline in the number of Direct Subscriber Line subscribers began in 2006 when year-on-year growth fell for the first time as users began to migrate to the high-speed, more reliable, and almost-as-cheap FTTH service. The proportion of Direct Subscriber Line contracts dropped below 50 percent of the total in September 2007. The number of cable television, common antenna television (CATV) broadband contracts continues to increase slowly, but overall market share is declining.

Increasing ultra-high-speed access (defined as 30 Mbps symmetrical access), as FTTH is described, is an important element of Japan's mid-term ICT policy. However, from the point of view of competition policy it raises concerns for the regulator as the incumbent telecommunications operator, NTT, is proving dominant in the FTTH market. In 2001 the Ministry of Internal Affairs and Communications (MIC) introduced an open access regime to the broadband market that required the NTT regional companies to release their copper access lines to broadband Direct Subscriber Line providers at low tariffed rates, and to share their networks and facilities. Access to low-cost copper and open access to elements of NTT's fiber network provided the foundation for the rapid growth of affordable broadband. It also created a new market where NTT is not dominant. Throughout the history of Direct Subscriber Line, despite NTT's control of the copper on which the service is based, the combined market share of NTT companies did not exceed 40 percent. In December 2007 SoftBank accounted for 37.6 percent of Direct Subscriber Line subscribers and the combined share of NTT East and NTT West was 37.1 percent, the first time that NTT had been outperformed in the national Direct Subscriber Line market. The successful introduction of competition to a new and essential market was a significant policy achievement for the MIC. However, NTT is now dominating the newer and faster growing FTTH market.

At the end of December 2007, NTT East and NTT West shared 71.4 percent of the FTTH market, an increase of 0.7 percent from the previous quarter and a year-on-year increase of 3.9 percent. Meanwhile, among NTT's main competitors, the power utility group carriers had a market share of 10.2 percent, no change from the previous quarter, and KDDI 6.1 percent,

down 0.2 percent in the quarter. In terms of overall broadband subscriptions the NTT companies controlled 45.8 percent of the market and at current growth rates can be expected to take more than 50 percent by the final quarter of 2008. Given that Japan's ICT policy aims for 20 million FTTH subscribers by the end of 2010, NTT's increasing dominance in the technology is a concern for the MIC.

With recent trends in broadband use, network capacity appears to be reaching saturation point. The estimated download traffic of broadband users in November 2007 was 812.9 Gbps, up from 721.7 Gbps in May 2007 and equivalent to 2.5 times the traffic three years ago (Esaki 2008). There are significant differences between daily peak traffic loads, which can be up to 95 percent of available bandwidth, and normal daily average use, which tends to be nearer 40–50 percent. Surveys have shown a significant increase in download from overseas, which may be explained by the popularity of video sharing sites and peer-to-peer (P2P) downloads of movies and other video content. Internet service provider (ISP) surveys show that a small number of users tend to use a disproportionately large amount of bandwidth. One Japanese ISP reported that 10 percent of users take between 60–90 percent of bandwidth, and the top 1 percent, 60 percent of total bandwidth.

Internet Exchange points, data centres, and major networks are finding it hard to deal with the additional and somewhat unexpected demand. With the MIC as an observer, four major ISP associations have drawn up guidelines for traffic management practices that ISPs may adopt to address the congestion problem. The draft guidelines include recommendations to allow packet shaping of excessive bandwidth consuming applications such as P2P, and means to restrict or cancel the contracts of heavy users who exceed certain traffic thresholds. However, the guidelines also emphasize the underlying principle that ISPs should increase network capacity in line with increases in network traffic — i.e. packet shaping cannot be used as an excuse for not making necessary infrastructure investments. The guidelines also follow the network neutrality principles and general open and fair access principles that characterize Japan's communication policy. As Japan leads broadband deployment, it faces policy issues not yet encountered by other countries. Unusually for Japan, it must take the lead in an important area of policy development rather than following the lead of either the US or Europe.[2]

At the end of March 2008, the number of cellular phone subscribers exceeded 104 million, with more than 91 million subscribers to third generation (3G) services and 89 million subscribers to mobile Internet services (TCA 2008). Revenues remain high but are declining. The average revenue per user (ARPU) across all providers in 2006 was JPY 6,662, down from JPY 6,769 in 2005 and a high of JPY 8,235 in 2001 (JPY 1 = USD

0.0089290, JPY 1,000,000 = USD 8,929 as of 1 January 2008). In 2006, voice ARPU was JPY 4,670 and data ARPU JPY 1,992. Data ARPU is increasing both in real terms and as a proportion of the total ARPU, a trend since 2001 (Taniwaki 2008) due in part to users making increased use of mobile devices to access Internet services, as well as to strong competition in voice plans to encourage subscribers to switch operators.

Digital mobile broadcasting is known as 'One-Seg' in Japan, from the digital terrestrial broadcasting channel being divided into 13 segments of which 12 are used for high-definition broadcasting and one segment is made available for mobile use. All free-to-air digital television broadcasts available to ordinary high definition television (HDTV) viewers are also available to mobile One-Seg viewers. The service is free, but handsets capable of receiving the broadcasts are required. One-Seg was launched in April 2006, and between June 2006 and December 2007 20 million One-Seg handsets have been shipped. According to the Japan Electronics and Information Technology Association (JEITA), these high-end expensive handsets boosted retail sales during the 2007 end-of-year shopping season.[3]

Another important development in the mobile sector has been the introduction of mobile virtual network operators (MVNO). To introduce new types of competition particularly at the service level, and to encourage more innovation and user choice, the MIC has introduced a policy that makes it possible for companies to lease operators' cellular networks and provide services of their own on top. The first MVNO, although not officially known as such, was eMobile, the mobile subsidiary of the Direct Subscriber Line wired broadband provider eAccess. eMobile offers 3G/HSDPA communications with speeds up to 7.2 Mbps nationwide. The company launched the service in March 2007 and with over 500,000 subscribers after one year of operation (TCA 2008) exceeded first year targets by more than 25 percent. One of eMobile's advantages is that it is able to offer a flat rate unlimited use plan nationwide by leasing capacity as a 'stealth' MVNO on DoCoMo's 3G network until it is able to complete building a full network of its own. In February 2008, eMobile announced that it would partner with Internet Initiative Japan Inc. (IIJ) to enable IIJ to become a MVNO operating on its HSDPA network. IIJ plans to use the high-speed data mobile service to complement the services it offers to business customers.

The first official MVNO was Japan Communications Inc. (JCI), which signed an agreement with DoCoMo in July 2007 to offer its own branded services over DoCoMo's network.

Japan's Mobile Ecosystem

Over 100 million mobile phones are in use in Japan, with approximately 50 million new handsets sold each year.[4] Handsets are becoming increasingly sophisticated devices: many have high-resolution LCD screens, over 40 million are contactless wallet phones, 22 million have the One-Seg digital TV function, and over 85 million are 3G. Thus, to be successful, any new Internet service must be available for both mobile and fixed access, whether the service is for individual use (such as video sharing or online shopping) or for business use (such as services built around Software as a Service or SaaS).

At the user service level, Japan is experiencing the first generation of Fixed Mobile Convergence. This dynamic market is built around a unique industry ecosystem, formed through interaction and collaboration between players in a given environment. First NTT DoCoMo with its renowned i-mode wireless Internet service, and later KDDI and Softbank, adopted a business model where they as network operators sit at the middle of an industry structure that enjoys an almost symbiotic relationship with handset makers, content providers, and platform vendors (or portals). Together they all serve the user in a market designed for their mutual benefit. Network operators benefit by providing opportunities to the handset makers, content providers, and platform vendors: when they gain more customers or sales, the network operators gain from an increased number of subscribers and increased traffic.

This is different from the model we see elsewhere in the world where the handset manufacturer is at the centre of the market and where it controls the relationship with network operators, content providers and platform vendors, usually through co-marketing activities. The Japanese model has created a situation where customer loyalty is first to the network operator, second to the handset, and third to content accessed through the handset. One outcome is the incredible success of the market: Japan accounts for approximately three percent of the world's mobile subscribers but 40 percent of total mobile data revenues.

Note: The authors are grateful to their colleagues at the International University of Japan, Philip Sugai and his students at the Mobile Consumer Behaviour Lab (http://www.mocolab.net/), for the source material for this case study.

JCI's services target enterprise customers, allowing them to match mobile with fixed line and other types of communications services. The MVNO option gives JCI the opportunity to add mobile voice and data service to an existing portfolio of communications and data products.

The MIC regards MVNOs as a means to stimulate new types of competition in a maturing traditional market. Openness to MVNO businesses sharing their network was a requirement when the MIC allocated a parcel of 2.5 GHz wireless spectrum for advanced mobile broadband. The two 'winners' in the process, which was conducted as a beauty contest rather than as an auction, were KDDI and the personal handy-phone system (PHS) operator WILLCOM. Both will open their new networks to MVNOs. KDDI will use the 2.5 GHz spectrum for services based on WiMAX technology to be launched commercially in the summer of 2009. WILLCOM will begin next-generation PHS targeting 20 Mbps downloads using orthogonal frequency division multiplex access (OFDMA) and MIMO technologies. WILLCOM aims to begin test services in April 2009 and commercial services in October 2009.

On 10 July 2008, one day before the iPhone was launched nationwide in Japan, eMobile began selling Eee PC 4G mini computers for just 100 yen, the first 'one dollar' laptop. Made by Taiwan-based ASUSTeK Computer Incorporated (Asus), the Eee PC is small, with a seven-inch screen, but is a fully functioning Linux or Microsoft Windows PC. The low price is possible because eMobile bundled sales of the Eee PC with a two-year subscription to either their 3.6 Mbps or 7.2 Mbps flat-rate mobile data service, at approximately USD 60 per month. Sales are reported to have been brisk (Takizawa and Sasaki 2008). The business model of subsidizing the cost of a device by subscription fees for related services is borrowed directly from the mobile phone market, where the cost of calls and monthly calling plans have long subsidized the high price of handsets (see 'Japan's Mobile Ecosystem').

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The IT Strategic Headquarters chaired by the prime minister was established in 2000 under the cabinet. It provides recommendations on key policy issues related to ICT.

The Council on Economic and Fiscal Policy (CEFP) is a consultative body chaired by the prime minister and administered by the cabinet office. It conducts consultations with industry experts on economic and fiscal policy formulation to achieve growth, innovation, and international competitiveness, and provides advisory services on ICT.

In September 2006, the MIC introduced the New Competition Promotion Program 2010 to review the framework of competition rules necessary for the transition to IP-based networks. The program is designing the roadmap for the discussions that will take place after 2010 regarding NTT reform and media convergence. A rolling series of working groups and councils is being formed to consider key issues, and the outcome of each is a building block in the creation of a comprehensive policy.

One of the MIC's key policy concerns is how to extend the principles of open access to the dominant operator's networks to the new next generation networks now being developed. Clearly, regulation based on old telephony models such as the interprefectural design that divided NTT's local access network into separate companies each serving different geographic regions of the country, has no relevance in the IP age. However, competitors will still need access to NTT's networks if they are to provide services. The MIC has developed a basic framework for network neutrality based on three principles:

- IP networks should be accessible to users and easy to use, allowing ready access to content and application layers.
- IP-based networks should be accessible and available to any terminal that meets relevant technical standards and should support terminal-to-terminal (or 'end-to-end') communication.
- Users (meaning both individual end users or network subscribers and content providers and other related companies conducting business using the Internet) should be provided with equality of access to telecommunications and platform layers at a reasonable price.

The MIC has also created a P2P task force to investigate the opportunities posed by P2P technologies to advancing network congestion. Although the MIC recognizes that P2P traffic is the cause of much of the current congestion, the MIC also believes that P2P technologies will be the answer to congestion in the future because of the efficiencies in traffic management that they can offer.

The Ministry of Economy, Trade and Industry (METI) is responsible for devices, hardware and software, but not the communications medium. Its new economic growth strategy is based around enhancing innovation and improving productivity through better utilization of ICTs. It has developed for different industry areas a raft of policies with a strong focus on accelerating technology innovation and knowledge sharing in the firm. METI notes that service industries account for 70 percent of Japan's economy, but many of those outside the IT sector make inefficient and ineffective use of IT, particularly in management.

Reducing these inefficiencies is one of METI's core policy goals and it is promoting the use of IT in Japanese business particularly with programs focused on improved training, business software applications, and programs designed to build trust in IT and the Internet (METI 2007).

ICT AND ICT-RELATED INDUSTRIES

The ICT industry, which includes organizations in the 'business of producing, processing, distributing and delivering information, and of providing required materials and equipment', is composed of the following industry segments: telecommunication, broadcasting, information services, audio-visual and textual content production, ICT manufacturing, information and telecommunication services, and ICT-related construction (MIC 2007b). In 2005, the ICT industry contributed JPY 93.7 trillion, or 9.9 percent of the nominal GDP of JPY 947.1 trillion, and accounted for 42.4 percent of the real GDP growth (MIC 2007b).

Japan's ICT industry is faced with the challenge of international competitiveness. Although it has the advantage in advanced consumer electronics, such as digital cameras, high-definition television, and state-of-the-art mobile handsets, it is lagging behind the US and Europe in core technologies such as routing and switching, encryption, and operating platforms. Moreover, Japan is likely to lose its edge in advanced consumer devices as other countries catch up and these products are commoditized.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Since taking office in September 2007, Prime Minister Takeo Fukuda has made the revitalization of local communities in the rural areas one of the foci of his administration and ICT is expected to play a significant role in this effort. In June 2007, the Council on Economic and Fiscal Policy headed by the prime minister announced the basic policies toward economic and fiscal reform of government and the nation to achieve growth, innovation, and international competitiveness (Cabinet Office 2007). ICT is referred to as a driver to improve the productivity of industry, particularly of the service industry.

The transition to digital television broadcasting and the termination of terrestrial analogue television broadcasts are to be completed by 2011. Fibre access is expected to reach 30 million households[5] and broadband will be available in all local communities across Japan by 2010. Likewise, discussion about the status of NTT and how the dominant telecommunications group should be regulated will begin in 2010.

These developments are only part of greater change where both broadcasting and communication are converging and will cause a comprehensive revision of the existing regulatory frameworks and business structures for both sectors.

The New IT Reform Strategy is a comprehensive schedule of policies addressing social reforms and the technology development required to enable Japan's vision of a 'ubiquitous network society'. The strategy seeks solutions to the problems Japan is facing now, such as the aging of society, the increasing divide between urban and rural areas, the revitalization of the economy, and improvement of national competitiveness. Its overall goal is to ensure that by 2010:

- Hundred percent of the population has high-speed or ultra-high-speed Internet access;
- Eighty percent of the population is able to appreciate the role of ICT in resolving social problems; and
- Eighty percent of the population feels comfortable with ICT.

The first and third goals are well developed. Eliminating 'zero broadband' areas is the cornerstone of the MIC's Next Generation Broadband Strategy, which is targeting that by 2010, 90 percent of households will be covered by ultra-high-speed broadband access, and other means of high-speed broadband access will be available in all areas of the country. The third goal involves strategies for improving security, safety, and trust in use of the Internet, including programs such as the 'cyber clean' centre supported by METI and the MIC, Keidanren, JPCERT, and leading businesses; the Internet Hotline Center for reporting illegal information and online conduct supported by the Internet Association Japan, the National Police Agency and METI; and the MIC's anti-spam initiative. The second goal is less developed. It was once estimated that only 45 percent of ICT users valued ICT as useful for solving problems such as those related to health, social welfare, education, and employment (MIC 2008c). While a more recent survey has found that 80 percent of respondents realize that ICT could serve various social needs, on average only 46 percent have actually used ICT to meet these social needs (MIC 2008d).

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

At present, broadcasting and telecommunication in Japan are administered under separate laws. However, as information communication networks become available nationwide and all communications move to IP-based networks, there is less need for this institutionalized separation. In 2006, an advisory

panel convened by then MIC Minister Dr Heizo Takenaka recommended that the current regulation, which is based on the vertical integration of industries, should be reformed based on a horizontal layer model, composed of transmission infrastructure (e.g. network and broadcast delivery), platform (e.g. content aggregation), and content (e.g. programming) layers supported by integrated communications regulation. The MIC is taking initial steps toward the convergence of broadcasting and telecommunications, and is consulting with various experts' groups to be able to meet the 2010 deadline.

Inter-ministerial efforts to ensure information security are administered by the National Information Security Center (NISC, http://www.nisc.go.jp/eng/index.html) under the Cabinet Secretariat. The basic strategy, released in February 2006, aims to 'make Japan an information security advanced nation through [the] establishment of a new public–private partnership model'. Information security is considered from four perspectives: national and local government, business infrastructure, personal safety and security, and national security. An initial three-year plan led to the creation of common information sharing and analysis functions called Capability for Engineering of Protection, Technical Operation, Analysis and Response, or CEPTOAR. Once a significant information security risk is revealed or an incident takes place, CEPTOAR works to bridge the activities of government and critical infrastructure operators and helps them share information for disaster prevention, response, or recovery. In 2007, the policy focused on upgrading information security measures to create an environment in which people can use IT safely and securely. In 2008 the strategy focus is on intensive efforts to enhance information security infrastructure: developing and improving human resources engaged in information security, adopting information security measures on an international scale, and enhancing information security in the provision of e-government services.

The protection of personal information is a high policy priority in fostering a secure and safe information society. The Act on the Protection of Personal Information, enacted in 2003, sets forth high-level principles that have subsequently been elaborated by a series of cabinet and ministerial orders. As of March 2007, 35 such guidelines had been published in 22 industry sectors. In principle, each ministry is responsible for personal data protection in its own 'jurisdiction' or area of policy competence. The cabinet office takes the lead in coordinating inter-agency level activities, but it does not have overarching authority to exercise government-wide enforcement.

Japanese data protection arrangements embody many aspects of self-regulation and co-regulation. Businesses handling personal information are expected to take the initiative in pursuing protection of personal information. Industry groups

and trade associations can be designated as 'Authorized Personal Information Protection Organizations' to promote industry-wide personal information protection. Labelling schemes such as Privacy Mark (http://privacymark.org/) and TRUSTe (http://www.truste.or.jp/) are also becoming common in Japanese industry.

DIGITAL CONTENT

The content industry as a whole, which includes both analogue and digital content, is estimated to be worth JPY 13,989 billion (DCAj 2007). The digital content industry was estimated to be worth JPY 3,663 billion at the end of 2007, a 10.7 percent increase from 2006. Packaged content represents 67.5 percent of the total revenues of digital content. Internet-delivered and mobile content represent 16.7 percent and 15.9 percent, respectively. Although packaged content still has a major share of the market, it is beginning to shrink and Internet and mobile content are growing steadily.

The 'Web of the Year' Awards (http://woy2007.sbcr.jp/nominate/) nominated 15 services for the special prize section in 2007. Some of the nominations were international, such as iPhone, Second Life, Wii, Google Earth, twitter, and YouTube, but the others were Japanese in origin, such as Kao Checki, Rimo, Nico Nico Douga (video posting and subtitling service), Hatsune Miku (desktop music software with a voice avatar), and Yahoo! Politics. These nominations show that user participation in content creation and sharing is increasingly important.

'Kao Checki' literally means 'Check your face'. Users submit a digital photo of their faces and the site returns images of celebrities who look similar to them. Rimo provides a 'couch potato' interface for YouTube and other video sites. It selects and plays back video clips based on user's preferences instead of users searching and browsing directly for the video clips of their choice. These services represent a trend of Internet users increasingly looking to the Internet for entertainment.

Nico Nico Douga (http://www.nicovideo.jp/), which literally means 'Smiling Video' and which is one of the most successful new services of 2007, is similar to YouTube in that it publishes video clips posted by users, but it has the unique feature of allowing users to add comments within the video. These superimposed comments, which appear as a continuous stream of subtitle-like text appearing over the top of the video image, are often little more than graffiti, but they add an aspect of user interaction with the video clip that anyone can respond or add to. The concept has gained wide appeal and Nico Nico Douga now has almost 8 million registered users, in addition to 204,000 premium users paying JPY 500 per month for additional privileges (Nico Nico Douga Ltd 2008). Nico Nico

Douga's business model is advertising-based, mixing advertisement placement mechanisms such as Google Ads, and a unique system that allows users to place banner advertisements on each video page.

A digitally networked environment allows users to generate and disseminate information. This trend is well accepted by Japanese Internet users with consumer-generated media now a rapidly growing genre of online content in Japan. An MIC survey on the uptake of blogging and social networking services (SNS) found that as of March 2005 3.35 million Japanese had a blog, of which 950,000 were considered to be active (defined as blogs updated at least once a month), and 16.51 million read blogs (MIC 2005).

ONLINE SERVICES

e-Government

In the UN Global e-Government Readiness Report Japan ranked 26th in 2002 and 14th in 2005, after the US, Denmark, Sweden, the United Kingdom (UK), and the Republic of Korea. From a technical point of view, Japanese e-government readiness should be much higher. For example, as of August 2006, 96 percent of transactions (such as filings and applications) with national government agencies could be carried out online. However, it is not clear how many transactions are actually being carried out online. Moreover, many services available online are poorly designed and they are not widely used. For example, the National Taxation Agency started to receive tax filings online in 2004 (e-Tax system), but businesses and citizens had to purchase dedicated software that is compliant with e-Tax requirements as well as electronic certificates, to actually file tax reports online. In 2008, the NTA redesigned part of its online service such that citizens can now file their income tax without dedicated software. This is expected to drive the usage rate upward.

e-Business

According to a 2007 METI survey of electronic commerce, Internet-based e-commerce transactions amounted to JPY 148 trillion in 2006, an increase of 5.3 percent from 2005. The largest user segment is manufacturing, accounting for 56 percent of the total transaction value. The volume of Japanese business-to-business (B2B) e-commerce in 2006 was estimated to be 147.9 trillion yen, larger than that of the US (JPY 95 trillion), although business-to-consumer segment is much smaller. While in the US e-commerce transactions between business and consumer amounted to JPY 15.9 trillion in 2005 and JPY 19.3 trillion in 2006, in Japan the volume of such transactions

was only JPY 3.5 trillion in 2005 and JPY 4.4 trillion in 2006 — a low figure considering that Japan's economy is roughly half that of the US. METI reports that Japanese consumers purchase information and content online more than other products, whereas American consumers purchase general retail products more than others (see 'SaaS: A New Hope for the Japanese Software Industry?').

e-Banking and e-Trading

Both consumers and businesses are making increased use of electronic banking. In many cases, PC-based and mobile Internet banking transactions are charged less than face-to-face or ATM transactions, an important factor in encouraging people to use online transaction channels. However, e-banking is not the major method for payment in e-commerce; credit cards and cash payment at convenience stores are commonly used to pay for online purchases.

The online trade of stocks and securities is also becoming common. Whereas from October 2001 to March 2002, only 1.8 percent of the total trading value was dealt with online, five years later, 24.7 percent, or JPY 128 trillion, of total trading value came from online trade (JSDA 2007).

One of the significant challenges for any online service, particularly e-banking and e-finance, is identity management. An increasing number of services are issuing user IDs, passwords, and electronic certificates that users have to manage and keep secure without losing track of them. Currently, a typical user might end up with a dozen or more user accounts. Some identities (IDs) can be changed, while others cannot. Some passwords can be in either lower or upper-case letters; others require only upper-case letters; and others require a combination of letters, numbers, and symbols. The point is that the whole chain of user IDs, passwords and electronic certificates, and the level of complexity involved, may be prohibitively high for many people who are not expert PC and Internet users. Indeed, it has become a somewhat commonly shared understanding that Japan is so obsessed with securing the system and protecting personal information that users cannot feel confident about using these systems.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

ICT is now widely used in education as a tool to aid learning and as a subject of study in its own right, although substantial benefits in terms of improvements to the education system as a whole are yet to be seen. The Ministry of Education, Science and Technology is also focusing on introducing ICT in school management and administration, and addressing issues

SaaS: A New Hope for the Japanese Software Industry?

Web-based service providers such as Google and a host of other companies are moving applications onto the Web. These applications range from generic office productivity suites such as word processing and spreadsheet, to more specialized software like customer relations management. Because they are hosted by the service provider through the Internet, client companies can concentrate on using the application without the bother of installing and maintaining software environment. This trend is often referred to as software as a service or SaaS because software is not packaged and sold as a product but is offered when and where users need it.

Both government and the ICT industry in Japan are paying close attention to SaaS as a way of revitalising a previous model of software development where software vendors develop customized software on a made-to-order basis. In 2007, the MIC and the application service provider (ASP) Industry Consortium Japan jointly established the ASP/SaaS Promotion Conference.

From a user's perspective, SaaS can make the operation and maintenance of software more reliable and efficient because software runs on the service platform of specialised service providers rather than that of users. The risk is that SaaS will not work when the system at the service provider's side or the network in between fails. In other words, users give away control over the service and service providers face the big challenge of ensuring the reliability and usability of the service.

Still, software vendors in Japan seem to be quite positive about going forward with the idea because SaaS reduces the total cost of business, and it is creating a new business opportunity based on aggregated user demands. At present the Japanese software industry is suffering from falling user demand due to factors such as the negative growth of the market and offshoring. SaaS could stabilize the revenue of software vendors as fees are incurred on an ongoing basis. In the long term, it could lead to the restructuring of the industry as a whole.

(Source: MIC 2007)

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around information disclosure in schools, such as privacy, security, transparency, and accountability.

The Programme for International Student Assessment (PISA) 2006 Survey of the Organisation for Economic Co-operation and Development (OECD) found that the rate of Internet use by Japanese students is much less than the OECD average: 22.3 percent for searching information compared to the OECD average of 52.3 percent; 5.7 percent for collaborating online compared to the OECD average of 29.4 percent; and 3.9 percent for referencing compared to the OECD average of 28 percent (OECD 2006). The overall low rate of Internet use is interpreted to show that Japan has lagged behind in the exploitation of ICT in spite of the relative abundance of technology and equipment (Nakamura 2008). But one possible explanation is that Japanese students are more familiar with mobile terminals rather than full-scale PCs, and while mobile terminals have many advanced functions, they fall short in terms of flexibility and programmability compared to PCs and they leave little room for user creativity. In the long term, this may undermine the ICT capability of the younger generation in Japan.

At the tertiary-education level, the take-up of e-learning is relatively slow. Many universities now have online content for non-degree or recurrent education purposes, but only a few universities (e.g. Shinshu University) offer a full four-year degree course where students can take most of the coursework online. The Cyber University (http://www.cyber-u.ac.jp/), established in Fukuoka in April 2007, offers four-year online courses, and allows students to obtain a bachelor's degree after at least four years of enrolment. As of November 2007, the university had 620 students enrolled in two faculties.

Tertiary education in Japan is often criticized as not being capable of training IT students to the level that the industry requires. To meet industry demands, the MEXT has started a three-year training program for 'advanced IT specialists'.

OPEN SOURCE SOFTWARE

Although open source software has become an essential component of ICT infrastructure in Japan, it is not likely to replace software made available under other licence schemes. Open source software is frequently used at the server side, but not at the desktop, except for browsers and other specialized tools.

The Open Handset Alliance announced an open source software platform for mobile handsets and services, and NTT

DoCoMo and KDDI were early supporters. This may point to a new dimension in open source software use in one of Japan's leading ICT markets.

In March 2007, the government published a set of guidelines for the government procurement of information systems (MIC 2007a). The guidelines require that information systems be based on specifications that are agreed in open participatory processes, that can be implemented by any party, and that have multiple implementations available in the market. The guidelines do not specify open source as a procurement requirement, although it clearly favours the open source approach.

ICT RESEARCH AND DEVELOPMENT

In November 2007, the MIC, the National Institute of Information and Communications Technology (NICT), and a number of major Japanese electronics manufacturers jointly established a new research and development (R&D) consortium called the New Generation Network Promotion Forum (http://forum.nwgn.jp/). This coincides with the Future Internet Design (FIND) initiative of the National Science Foundation in the US and the Future Internet Research and Experimentation Initiative under the 7th Framework Programme of the European Commission. The forum is expected to deliver a new generation of technology offering high speed and adaptability, high usability and quality, security, and efficient energy consumption (MIC 2007d).

CONCLUSION

To sum up, Japan is implementing various state-of-the-art technologies and services, ranging from broadband to mobile to digital television, and the ICT industry has a positive impact on overall economic performance. While there are growing concerns about the competitiveness of the fixed broadband market, fast and cheap services are very widely available, and mobile services are among the most advanced in the world. Together, the fixed and mobile communications sectors provide a strong foundation on which many innovative businesses and services are flourishing and the goal of achieving a 'ubiquitous network society' is realistic.

But while e-business is growing significantly, particularly in B2B transactions, and many innovative services are emerging (e.g. Nico Nico Douga Ltd), these tend to cater to entertainment and fun, rather than addressing real-world problems and providing new services for consumers. Moreover, the Japanese software industry is not internationally competitive, although the emerging area of SaaS shows promise in changing this situation

for the better. As previously noted, the use of ICT in education is not yet building competitive ICT capability among students. Overall, the transformative impact of ICT on daily life has yet to be seen. An important challenge for ICT in Japan is how to make sure that technological innovations contribute to improving society, particularly as tools for solving real-world problems such as unemployment and poverty, and as tools for social welfare management and corporate governance. Otherwise, the impact of ICT may be undermined in the long term.

A good sign is that government, industry, and individuals are becoming more concerned about what they do with ICT. Indeed, Japan needs to become a test bed not just for new cutting-edge technologies but also for using ICT to share information, communicate with people, and improve all aspects of life in society as a whole.

NOTES

1. Actual prices depend on types of service package taken, promotional offers and other incentives, but Direct Subscriber Line services with speeds ranging from 8 Mbps to more than 50 Mbps are available with service packages priced from USD 22 per month, and 100 Mbps FTTH from approximately USD 35 per month.
2. Two presentations providing a comprehensive overview of Japanese communications policy, including broadband and P2P, are available from http://www.too-much.tv/2008/03/japan-broadband.html (Too-Much-TV 2008).
3. One-Seg is not limited to mobile phones. Many devices with a screen such as electronic dictionaries and encyclopaedias now come with One-Seg capability, as do some laptop and desktop computers and USB devices.
4. According to the Japan Electronics and Information Technology Industries Association (JEITA, www.jeita.or.jp), 44,908,000 handsets were shipped between April 2007 and February 2008.
5. NTT lowered the target down to 20 million households in 2007. It is not yet known how it affects the policy setting of the MIC.

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Korea, Democratic People's Republic of

Heejin **Lee**, Seungkwon **Jang**, and Kyungmin **Ko**

Total population	23,301,725 (July 2007 est.)
GDP per capita	USD 1,900 (2007 est.)
Key economic sectors	Military products; machine building, electric power, chemicals; mining (coal, iron ore, limestone, magnesite, graphite, copper, zinc, lead, and precious metals); metallurgy; textiles, food processing; tourism
Computers per 100 inhabitants	NA
Fixed-line telephones	980,000 (2003)
Mobile phone subscribers	20,000 (2004)
Internet users per 100 inhabitants	NA
Broadband subscribers per 100 inhabitants	NA
Internet domestic bandwidth	NA
Internet international bandwidth	NA

(Sources: CIA 2007; Yonhap News 2005)

OVERVIEW

The development of information and communication technology (ICT) in North Korea requires the resolution of international conflicts regarding North Korea's nuclear weapons. In 2007, there were positive signs in this regard, such as improving relations between the United States (US) and North Korea and the second summit between South and North Korea held in October 2007. However, considering the complicated history of negotiations regarding North Korea's nuclear weapons, the situation can be reversed any moment. For example, with the election of the new president of South Korea in December 2007, the South–North relationship in the Korean peninsula has entered a new phase that is different from the one under the previous two administrations in South Korea where cooperation between South and North was considered as something to be maintained at any cost. Furthermore, the relationship between the US and North Korea that until recently seemed to be improving and leading to the verifiable denuclearization of the Korean peninsula, switched into another wave of distrust and hostility in September 2008.

Although there has been little change in the reported[1] digital situation of North Korea since the 2007–2008 edition of the *Digital Review of Asia Pacific*, this chapter reports some changes that have significant implications for digital development in North Korea. These changes include the improving, although volatile, US–North Korea relations, the changing relationship between South Korea and North Korea, the Kaesong Industrial Complex, and the Pyongyang University of Science and Technology.

IMPROVING INTERNATIONAL RELATIONS

It is generally agreed that North Korea cannot make significant progress in ICT development without improving its relationship with the US. This is because the Wassenaar Arrangement established in 1996 bans countries that endorsed it from exporting to North Korea high-technology materials and technologies that can be converted to military use. This international policy can be reversed only when the US removes North Korea from its list of terrorist states. Moreover, North Korea cannot afford the large capital required to build a telecommunication infrastructure for advanced technology industries. This kind of investment can only be infused from the outside. Without the implicit agreement of the US, no country and no investor will make such an investment in North Korea.

Since early 2007, however, there have been significant improvements in the relationship between North Korea and the US. In particular, there has been significant progress in efforts to achieve a verifiable denuclearization of the Korean peninsula through the Six-Party process (Hill 2008). On 13 February 2007, an agreement on 'Initial Actions for the Implementation of the Joint Statement' was reached between North Korea and the US in which North Korea promised to shut down and seal the core nuclear facilities at Yongbyon. North Korea also agreed to invite back the International Atomic Energy Agency (IAEA) to conduct monitoring and verification activities.

On 3 October 2007, the 'Second Phase Actions for the Implementation of the Joint Statement' was agreed upon.

Specifically, North Korea agreed to disable all existing nuclear facilities, starting with disabling the three core facilities at Yongbyon by the end of the year. North Korea also agreed to provide a complete and correct declaration of all of its nuclear programs by the end of 2007. North Korea did not meet the 31 December 2007 deadline for this commitment. If the commitments agreed in the 3 October 2007 Agreement are fulfilled, the US will rescind the designation of North Korea as a state sponsor of terrorism and terminate the application of the Trading with the Enemy Act (TWEA) to North Korea.

Upon the completion of the Second Phase Actions, the Final Phase will be marked by the cessation of North Korea's existing nuclear programs, dismantling of all nuclear facilities and nuclear weapons, capture of all fissile material produced by North Korea, and verification of North Korea's denuclearization. In exchange, the US is prepared to resume full diplomatic relations with North Korea.

In May 2008, an official of the US State Department crossed the South–North border with 18,000 pages of documents handed over by North Korea. The documents contain records of North Korea's plutonium activity, including detailed logs of how much plutonium has been produced. The documents are examined to determine whether they are legitimate and helpful for scientific verification. The turnover of the documents was considered a significant gesture on the part of North Korea to show that it was committed to the negotiation (*Korea Herald* 2008).

North Korea also destroyed the cooling tower in Yongbyon on the 27 June 2008 to show its commitment to the disarmament deal with the US. However, North Korea was not taken off from the US list of state sponsors of terrorism. The US argues that Pyongyang has to agree on the long-delayed verification mechanism. In return North Korea is threatening that it would restore its nuclear plant.

Despite some delay in the complete and correct declaration of all of North Korea's nuclear programs, the two parties are expected to make progress on the Agreement. For North Korea, an improvement of its relationship with the US and its removal from the list of terrorist states are essential to receive the international aid and foreign investments that it desperately needs for its economic development. For the Bush administration, improved relations with North Korea should repair some of the damage to its reputation caused by failures in the war in Afghanistan and Iraq.[2]

CHANGING RELATIONS BETWEEN SOUTH AND NORTH

The slowly improving bilateral relations between North Korea and the US served as a backdrop for the 2nd South-North summit held in October 2007. The summit produced some agreements that can contribute to infrastructure building in North Korea, including the Kaesong Industrial Complex (see the next section).

However, since the election in December 2007 of the new South Korean President Lee Myung-bak, relations between South and North Korea have chilled. The new South Korean administration is very critical of the policy of engagement toward North Korea of the two previous administrations. The previous administrations saw economic cooperation with (or aid to) North Korea as essential to its unification policy, which was named the 'Sunshine Policy' because the 'sun' of economic benefits would continue to shine on the Korean peninsula even on 'cloudy' days marked by disputes. This policy was to help ease the economic difficulties of North Korea and improve the internal relationship between South and North. But the conservative opposition party at the time, which is now the ruling party, had opposed the Sunshine Policy, arguing that the economic aid only helped the North Korean regime to survive its economic hardships and the aid was being used for military purposes.

As soon as the new South Korean government came to power, the president announced that he opposed unconditional assistance to North Korea and called for its nuclear disarmament as a precondition for economic cooperation. North Korea responded head-on to this policy change by expelling South Korean officials from the Kaesong Industrial Complex and test-firing missiles (The Associated Press 2008). Considering the hard-line stance taken by both sides, it will take time to return to the cooperative relationship of the last decade. And this is not a favourable situation for the development of ICT in North Korea.

KAESONG INDUSTRIAL COMPLEX

The Kaesong Industrial Complex, a special economic district, is an economic cooperation project between South and North Korea. Kaesong is a North Korean city located just 60 kilometres from Seoul and 160 kilometres from Pyongyang. It has easy access to Incheon International Airport and Incheon Port (Figure 25.1). The complex combines capital and technology from South Korea and the abundant land and labour of North Korea. It began in August 2000 when a contract was signed between Hyundai Corporation and North Korea's Asia Pacific Peace Committee. In November 2002, the North Korean government released the 'Regulations for the Kaesong Industrial District', and in June 2004 the first 15 companies set up their plants. As of July 2008, 72 companies were in operation, employing 30,084 North Korean workers and about 1,300 South Koreans (Kaesong Industrial District Management Committee 2007).

Figure 25.1
Location of the Kaesong Industrial Complex

(Source: Kaesong Industrial District Management Committee 2007)

Currently, the Kaesong Industrial Complex houses labour-intensive manufacturers of shoes, bags and clothes, and similar goods. The plan is to subsequently focus on technology-intensive industries and cutting-edge technology industries, including ICT. For such industries, electricity and telecommunication infrastructure need to be built. At present, the Kaesong Complex is supplied with electricity from Munsan in South Korea by KEPCO (Korea Electric Power Corporation). KT (Korea Telecom) is providing the phone lines. However, Internet access and mobile communication are not available at the complex, which is a source of complaints from South Korean workers and companies.

Although the Internet is recognized in North Korea as increasingly important, only the privileged are allowed to use it. Among authoritarian states, North Korea exerts the tightest control over the Internet. North Korean leaders are concerned about the impact of the Internet on the stability of the regime. However, the North Korean government also recognizes the potential economic value of the Internet. Thus, it faces the dilemma of whether to court political instability in exchange for economic gains by opening up the Internet. Without opening up the Internet, it will be very difficult to attract further investment from South Korean companies and foreign investors. However, there are some positive signs. During the second summit in October 2007, it was agreed that measures would be taken to ease transportation, communication (in particular, Internet access[3] and mobile communication[4]) and customs clearance for the Kaesong Industrial Complex.

It was reported that the Korea Software Financial Cooperative (KSFC) was planning to set up software centres, provisionally called the Korean Peninsula Software Cooperation Centre, in Kaesong and Pyongyang (Kim 2007). KSFC consists of about 1,000 software firms, including high profile companies such as Samsung SDS, LG CNS, SK C&C, and PosData. They expect to use talented North Korean programmers at lower prices and address the shortage of high-quality software engineers

in South Korea. This partnership will earn North Korea the dollars that it needs and allow its engineers to learn advanced technology. Most of all, while working with the South Korean engineers, the North Koreans could develop capabilities in market development that they lack, because they have never been exposed to demands from sophisticated customers. North Korean companies could also tap foreign markets through South Korean companies' linkages to the world market.

However, it is just the start of the negotiations and it will take some time to open the centres. Thus, KSFC has entered into an agreement with the Pyongyang University of Science and Technology (PUST), which is scheduled to open in 2008 (see 'ICT Education'), to set up a training centre for software within the PUST campus. The centre will recruit about 100 talented software engineers and focus on practical skills that can be immediately utilized for South Korean software companies.

ICT EDUCATION

Top universities in North Korea such as the Kim Il Sung University, the Kim Chaek University of Technology, and the Pyongyang University of Computer Technology have dedicated units for computer science and software engineering. The focus of ICT education is software as Kim Jong-Il has often emphasized the strategic importance of the software industry in the 'Single Leap' of the North Korean economy. The Single Leap strategy aims not for catch-up but for breakthrough (Bae 2001; Hahn 2003; Seo 2001).

However, it is not easy to educate high-quality engineers and develop ICT and software industries without infusion of state-of-the-art knowledge from abroad. In this sense, the opening of the PUST (www.pust.net or www.pust.or.kr) is a promising development. The PUST is the first international university in North Korea, with English as the medium of instruction and staffed by academics from around the world. It is being built on a 100-hectare plot leased by the people's army. With 45 faculty members, the PUST will offer master courses in computer science, electronics, agricultural engineering, and business administration as an initial cohort of about 150 students. It is expected to have 2,600 undergraduate and postgraduate students.

Its founders envision the PUST as a Silicon Valley-style industrial cluster that would generate jobs and revenue. The university is modeled on the Yanbian University of Science and Technology (YUST) founded in 1992 in Yanji, the capital of Yanbian Korean Autonomous Prefecture in China's Jilin province, just over the North Korea–China border. The leading founder of the PUST set up the YUST, the 1st Chinese

university jointly founded with foreign participants, and he has been running YUST successfully. Therefore, it is expected that the PUST will be on track shortly. However, some observers remain cautious because of the unpredictability of the North Korean situation. The project has already suffered from several delays caused by missile and nuclear tests and the resulting lack of funds. Nevertheless, despite some concerns, once it is open PUST will become the centre of ICT education in North Korea.

FUTURE OF ICT DEVELOPMENT IN NORTH KOREA

As described in the chapter on North Korea in the 2007–2008 edition of the *Digital Review of Asia Pacific* and partly in this chapter, North Korea has made various attempts in ICT development. However, the 'Single Leap' for North Korea's development is not possible without a dramatic increase of investment in ICT. This kind of investment in ICT infrastructure and the education system has yet to come.

Surely, due to the recent easing of the political tension between North Korea and the USA, the prospect for North Korea's ICT development will be better than in the past year. However, there are many known and unknown obstacles for ICT cooperation between North and South Korea, particularly with the chilling of the relationship between the two countries. Fewer cooperation projects than anticipated have been implemented. South Korean entrepreneurs and business people do not underestimate the unstable and unpredictable nature of North Korea's policies. They are reluctant to invest in a country where everything is always unpredictable and where politics overrides business.

In conclusion, it may be predicted that there shall be another set of ups and downs in the North–South cooperation in ICT. As borne out by previous experience, there will be some positive signals as well as some negative developments, at least for the time being. What is clear is that it is very unlikely for North Korea's ICT sector to be developed without North–South cooperation. Thus, it seems likely that it will take not one but several years for ICT development in North Korea to be realized.

NOTES

1. For example, there is no update on the state of telecommunications infrastructure in North Korea in the *The World Telecommunication Development Report* of the International Telecommunication Union (ITU) and CIA's *The World Factbook*. It is difficult to get reliable

information on ICT in North Korea and the information that is available is not always accurate. The data reported in this chapter come mostly from media reports.

2. With the 2008 US presidential election, the time for the resolution of the North Korea nuclear issue has run short and the motivation of the Bush administration to make a nuclear deal has weakened. It is likely that the North Korean issue will remain unresolved and it will be handed over to the coming administration.

3. During his visit to Pyongyang, the former South Korean President Roh Moo-hyun was reported to have asked Kim Jong-il whether South Korean companies operating in Kaesong could have Internet access. Kim's response was, 'I'm an Internet expert, too.' He was quoted by the Associated Press to have said: 'It's all right to wire the industrial zone only, but there are many problems if other regions of the North are wired. If that problem is addressed, there is no reason not to open.' He did not elaborate what those problems are (Cheng 2007).

4. Orascom Telecom, an Egyptian mobile operator and the fourth biggest Arab mobile phone operator, was granted the mobile phone licence in North Korea. The company will invest USD 400 million on infrastructure and licence fees over the next three years. The licence is for 25 years, with an exclusivity period of four years (Reuters 2008). The services will use wideband code division multiple access (W-CDMA), a third generation (3G) technology used in South Korea, which implies roaming services between the South and the North. The use of mobile phones was banned after an explosion in the city of Ryongchon adjacent to the border of China in April 2004 (The Dong-a Ilbo 2008).

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Korea, Republic of

Jong Sung **Hwang** and Sang-Hyun **Park**

Total population	48,456,000 (2007)
Literacy rate	97.8% (2002)
GDP per capita	USD 20,045 (2007)
Computers per 100 inhabitants	54.1 (2006)
Fixed-line telephones per 100 inhabitants	48.1 (2007)
Mobile phone subscribers per 100 inhabitants	89.1 (2007)
Internet users per 100 inhabitants	76.3 (2007)
Domain names registered under .kr	930,485 (2007)
Broadband subscribers per 100 inhabitants	30.2 (2007)
International Internet Bandwidth	49,766 Mbit/s (2006)

(Sources: KOSIS 2007; NIA 2008a, 2008b)

INTRODUCTION

The Republic of Korea (referred to as Korea throughout this chapter) has consistently sought to keep pace with fast-changing information technology (IT) trends and become a full-fledged knowledge-information society. In the mid-1980s, Korea laid the foundation for informatization through the construction of the National Basic Information System (NBIS) in five major areas, namely, National Administration Information System, Financial Information System, Education/Research Information System, National Defense Information System, and National Security Information System. The NBIS is the first grand project focusing on deploying strategic IT applications and systems at the national level. In the mid-1990s, the Ministry of Information and Communication and the Informatization Promotion Committee (IPC) were created to promote national informatization, and the government enacted the 'Framework Act on Informatization Promotion'. Based on this, the 1st Master Plan for Informatization Promotion was formulated in 1996. Since then, the government has effectively pushed ahead with informatization, guided by a vision that is continually updated in response to the IT evolution — from Cyber Korea 21, to e-Korea 2006, to Broadband IT Korea Vision 2007, to the u-Korea Master Plan.

The informatization efforts of the government and the private sector in the last two decades have enabled Korea to build advanced IT infrastructure. All public services are available online, enabling citizens to print civil service documents, pay their taxes, and participate in political processes. Moreover, the Korean IT industry has consistently recorded high growth rates. In 2007, the IT industry's share in the total Gross Domestic Product (GDP) exceeded 16.9 percent and its contribution to

GDP growth was 30 percent. IT export and production are expected to show fair growth in 2008 as well.

IT is being applied to several fields. For example, students and teachers are benefiting from various e-learning programs such as cyber home learning and online university education. Korean netizens are posting their own content online through user-created content (UCC) websites. Thus, they are actively participating in the construction of the Internet and leading the Internet culture. However, easy access to the Internet has brought about a number of social problems, including Internet addiction and verbal violence in cyberspace. The Korean government is working on improving legal systems and providing assistance to individuals who are suffering from these problems.

With the inauguration of a new administration in February 2008, the government underwent a large-scale reorganization and the responsibilities of the Ministry of Information and Communication were distributed among existing and new ministries as Korea aims for ever more advanced levels of informatization.

TECHNOLOGY INFRASTRUCTURE

To achieve the vision of a ubiquitous network society where all objects are intelligent and networked to one another, the Korean government continues to enhance the country's IT infrastructure. In particular, the government has been pushing forward with policies and projects to construct the Broadband Convergence Network (BcN) and Ubiquitous Sensor Network (USN), and to promote the spread of Internet Protocol version 6 (IPv6) (NIA 2007a).

The BcN is a next-generation network integrating communications and broadcasting, wired and wireless services, and voice and data services. The construction of the BcN is expected to enable the provision of broadband multimedia service to 10 million fixed-line subscribers at speeds of 50–100 Mbps, and to 10 million wireless subscribers at speeds over 1 Mbps by 2010.

The USN is an information service infrastructure through which sensor nodes are networked with each other to recognize, integrate, and process information on humans, objects, and environments, thus enabling all people to use the information at will, anytime, anywhere. To come up with practical service models and commercialize them, USN pilot tests are being carried out in food and drug management, airline baggage management, munitions management, and road facilities management, among others.

In a ubiquitous network society, personal computers (PCs), electronic appliances like televisions and refrigerators, handheld devices such as personal digital assistants (PDAs) and mobile phones, cars, street lights and buildings will be connected to the Internet. This poses the threat of Internet Protocol (IP) addresses running out. To prepare for this possibility, the Korean government has released the 'Plan for accelerating adoption of IPv6', which requires research networks to adopt IPv6 in 2008 and provide IPv6 as a test bed network to communications equipment vendors and Internet service providers (ISPs). By 2010 public sector networks and systems should support both Internet Protocol version 4 (IPv4) and IPv6. ISPs are expected to adopt IPv6 for their major transport network by 2010 and for all access networks by 2013.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

To promote national informatization in a systematic and efficient manner, the government reorganized the Ministry of Postal Service into the Ministry of Information and Communication in 1994 and unified information and communication-related efforts scattered across several ministries and offices. In June 1996, the Informatization Promotion Committee (IPC, http://www.ipc.go.kr) was created to take charge of national informatization plans and projects. The committee is chaired by the prime minister and comprises 25 members, including the ministers.

With the inauguration of President Lee Myung-bak in February 2008, the country's government ministries and agencies underwent a sweeping reorganization and their information and communication related work was adjusted. The Ministry of Information and Communication was absorbed into the new Korea Communications Commission (KCC, http://www.

kcc.go.kr) established to regulate both broadcasting and communications.

Responsibility for promoting national informatization and the ICT industry was transferred to two newly created ministries, the Ministry of Public Administration and Security (MOPAS, http://www.mopas.go.kr) and the Ministry of Knowledge Economy (MKE, http://www.mke.go.kr). The MOPAS integrates the functions of the Ministry of Government Administration and Home Affairs (MOGAHA) and the Ministry of Information and Communication. It has organized the Informatization Strategy Office for the promotion of e-government and national informatization. To be more specific, the Office is charged with establishing master plans for national informatization, promoting e-government projects, developing policies for protecting personal information and privacy, narrowing the digital divide, and training the IT workforce.

The MKE was created by integrating the functions of the Ministry of Commerce, Industry and Energy (MOCIE), the ICT industry promotion function of the Ministry of Information and Communication, and the promotion of ICT research and development (R&D) of the Ministry of Science and Technology (MOST). Thus, the new ministry unifies the government's policies for the development of the ICT industry and promotes the growth of all industries through ICT.

National agencies that had been under the control of the Ministry of Information and Communication now belong to the new ministries. The National Information Society Agency (NIA, http://www.nia.or.kr), which helps the government develop national informatization master plans and establish e-government, and the Korea Agency for Digital Opportunity and Promotion (KADO, http://www.kado.or.kr), in charge of programs for closing the digital divide, are now under the MOPAS. The Institute for Information Technology Advancement (IITA, http://www.iita.re.kr), which supports ICT R&D and trains IT professionals, is now under the MKE.

ICT AND ICT-RELATED INDUSTRIES

The ICT industry has been the biggest engine of Korea's economic growth since the 1990s. Semiconductors, computers, and telecommunications equipment have been particularly strong. Total sales in the IT industry in 2007 increased by 4.5 percent from 2006 to KRW 267.594 trillion, and a high growth rate of 8.3 percent per year has been maintained since 2000 (NIA 2008b).

The production of the IT services sector has increased an average of 8.1 percent every year since 2000 and 5.1 percent from 2006, accounting for KRW 54.521 trillion or 20.4 percent of the total production.

IT equipment production in 2007 increased 4.4 percent from 2006 and an average of 8 percent since 2000 and has now reached KRW 190.257 trillion or 71.1 percent of the total production volume. As the export of telecommunications equipment like mobile terminals has increased, IT equipment production maintained a relatively stable growth despite the world's economic crisis caused by the high price of raw materials and oil. It is likely that the demand for mobile phone terminals could have contributed to the gradual growth of mobile phone production, and the growth of display panel production caused by price stabilization led the entire IT equipment production.

Software and computer-related service production increased 3.9 percent from 2006 and an average of 11.4 percent yearly since 2000, reaching KRW 22.816 trillion or 8.5 percent of total production. The increase somewhat slowed because of a decrease in large-scale IT investment, stagnation of the domestic market, and the possibility of a worldwide recession. However, the yearly average growth rate remains high.

IT exports in 2007 increased 10.5 percent to USD 125 billion despite difficulties in the market caused by the US subprime mortgage crisis, the exchange rate crisis, and the general decrease in the price of IT products. However, although it has recorded a two-digit increase for two consecutive years, this is lower than the growth rate of computing industry exports and the figure has been dropping after going up to as high as 36.9 percent in 2004.

IT imports in 2007 increased 9.9 percent to USD 64.75 billion, and showed a gradual one-digit annual increase for three years since 2005. The IT trade balance was USD 60.33 billion in surplus, which is about four times the balance of the computing industry (USD 14.64 billion in surplus).

IT production is expected to grow 5.7 percent to a record KRW 278.3 trillion (around USD 278.3 billion) in 2008 (KISDI 2007).

KEY ICT POLICIES AND PROGRAMS

The enactment of the Framework Act on Informatization Promotion and the creation of the IPC in 1996 paved the way for the advancement of information technology nationwide. The Korean government formulated and carried out the 1st Master Plan for Informatization Promotion in 1996, which reflected 10 key tasks for accelerating the advancement of information technology (Song 2006). In 1999, the Korean government launched Cyber Korea 21, the second master plan for informatization promotion. Cyber Korea 21 envisioned the construction of a creative knowledge-based economy for the 21st century and proposed a number of strategies and policy tasks to be carried out by 2002.

It contributed to the spread of the Internet and the promotion of the digital economy in Korea.

In 2002, the Korean government launched e-Korea Vision 2006 in response to the challenges of the new millennium, notably the globalization of the world economy and the rapid shift to a knowledge-information society. Its aim was to transform Korea into a global leader through the continued enhancement of broadband IT networks. The Broadband IT Korea Vision 2007 announced in December 2003 highlighted the government's commitment to improve administrative services through the implementation of open e-government; strengthen national competitiveness by applying IT to industries; construct a broadband convergence network; develop new IT growth engines; achieve a GNI per capita of USD 20,000; and become a global leader by strengthening international cooperation.

The emergence of ubiquitous technologies prompted a revision of the Broadband IT Korea Vision 2007 into the u-Korea Master Plan in March 2006 (Ministry of Information and Communication 2006). Under the Plan, the government intended to achieve FIRST, or the five key visions of 'Friendly Government', 'Intelligent Land', 'Regenerative Economy', 'Secure and Safe Social Environment', and 'Tailored u-Life Services'. It also intended to optimize four major engines (BEST): Balanced Global Leadership, Ecological Industrial Infrastructure, Streamlining Social Infrastructure, and Transparent Technological Iinfrastructure. The successful implementation of these tasks would result in ubiquitous technologies being applied to every sector of society, improved national competitiveness, a higher national income, and improvements in the quality of public life.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

In Korea, laws on informatization are broadly divided into five categories according to their functions. The first category includes laws for building the infrastructure for an information society. The second category consists of laws supporting the revitalization of information services, including laws supporting informatization of private and public services. The third category includes laws fostering and advancing the ICT industry, as well as laws for developing new growth engines. Laws creating an environment for fair use of knowledge and information are included in the fourth category. The fifth category includes laws for preventing all sorts of malfunctions and adverse effects of informatization, including cybercrimes, the circulation of harmful information, the digital divide, invasion of privacy, and the like.

The significant ICT-related laws are the e-Government Act, Electronic Signature Act, Act on Managing Knowledge Information Resources, Act on Closing the Digital Divide, Act on Promotion of Utilization of Information and Communication Network and Data Protection, Telecommunications Business Act, e-Financial Transaction Act, and Act on Security of Personal Information Processed by Computers in IT Networks.

DIGITAL CONTENT

UCC is attracting more public attention than any other type of digital content. In the early stages, UCC consisted of personal commentary shared with friends. However, it is now evolving into proteur-created content (PCC), or content made by a 'proteur', a term coined by combining 'professional' and 'amateur'.

According to a survey conducted in April 2007, 74 percent of Internet users in Korea view UCC more than once a month. More than half of Internet users (51.1 percent) have experienced producing UCC, and 35.2 percent produce and post UCC on the Internet more than once a month. About half of those surveyed participate in UCC production by posting responses or comments (43.8 percent), evaluating them (41.6 percent), recommending them to acquaintances (40.7 percent), or copying them to post on other websites (38.8 percent).

The production of video UCC has also been increasing. The popular Korean video UCC sites are Gom TV (http://www.gomtv.com), Pandora TV (http://www.pandora.tv), Mgoon (http://www.mgoon.com), and Afreeca TV (http://www.afreecatv.com). The key to the success of these websites is to realize a profit through their UCC service. YouTube, a popular US-based video sharing website, is trying to develop a profit model for video UCC. Korean UCC websites usually derive profits from inserting a short video advertisement before content is played.

ONLINE SERVICES

The Korean government has focused on providing public services through the Internet to improve their accessibility. As a result, Korea was ranked sixth in the 2008 UN e-Government Readiness Index and second in the 2008 e-Participation Index (UN 2008).

The first steps in e-government were focused on putting key administrative information into databases. In 2001, 11 major e-government initiatives were undertaken, including the Government-for-Citizens (G4C) portal, e-Procurement System, and National Finance Information System. Through these initiatives, the Korean government has been able to integrate online services, and adopt single-window e-government. Customers can report taxes, pay bills, and lodge complaints electronically. The kinds of certificates that can be issued or read online are also increasing (NIA 2007b).

The National Police Agency has launched a website through which people can report crimes, give information, or call the local police in an emergency.

Another example of online public services is the UNI-PASS of the Korea Customs Service (KCS, http://portal.customs.go.kr). UNI-PASS, the world's first 100 percent electronic clearance portal system, provides a one-stop PASS service by unifying all customs clearance procedures, including export/import clearance, duty drawback, inbound/outbound passenger control, and tracking of bonded cargo (MOGAHA 2007). The development of the system was made possible through intensive consultations with customs clients. With UNI-PASS, customs procedures can now be carried out at home, at the office, on the production site, or any place with an Internet connection.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

The Korean government has promoted e-learning programs since 1997. The e-learning formats used include cyber home learning (http://www.kkulmat.com/index.jsp) and Educational Broadcasting System (EBS) online lectures (http://www.ebsi.co.kr/) for students preparing for the College Scholastic Ability Test (CSAT).

The cyber home learning program, which was started in April 2005, is for primary and high school students who are in need of supplementary study. Following an assessment of its effectiveness, the program has been systematically promoted by the government. The number of subscribers, which has increased steadily since the beginning of the service, was about two million at the end of 2006. Moreover, the daily average of visitors more than tripled in 2006, and nearly 200,000 people now access cyber home learning websites daily. Some 3,000 cyber classes are offered every semester and the number of students managed by cyber class teachers has reached about 170,000.

EBS lectures for the CSAT were launched in 2004 to help reduce the cost of private tutoring. The number of students subscribed to the service grew from 740,000 students in April 2004 to 2.5 million (60 percent of all high school students) as of the end of 2006.

e-Learning is also being applied to teacher training. Distance education programs for teachers have contributed to strengthening teachers' capacity and improving the quality of education.

Higher educational institutions in Korea are also utilizing e-learning. One hundred fourteen four-year universities (56.7 percent) are using e-learning to deliver 13 percent of their lectures. There are also 15 four-year and two two-year fully online universities in Korea. As of 2006, some 50,000 full-time students and 34,000 'pay-by-the-class' students were enrolled in online universities, and an estimated 130,000 people had graduated from online universities. Online or cyber universities are now classified as regular universities according to the Higher Education Act.

Public organizations and private firms are also utilizing e-learning for employee training. According to the e-Learning Industry Development Act of 2004, about 20 percent of the training courses for public servants is offered through e-learning. The Cyber Education Center, which was established by the Central Official Training Institute to provide training for government officials, has opened about 40 cyber classes and produced about 20,000 trainees. As one of the cities that are actively using e-learning to train public officials, Seoul City has opened some 140 classes and nearly 35,000 public servants have completed the training course.

Gyeonggi Province has established the Gyeonggi Women's e-Learning Center and about 50 classes for women to help them get jobs. The centre is focusing on developing e-business content and IT education for women who want to set up their own business. As of 2006, the e-learning use rate was about 33 percent for firms with over 50 employees.

The e-learning user market volume or e-learning expenditure of formal educational institutions, government, public institutions, businesses, and individuals increased 7.1 percent to KRW 1.728 trillion in 2007 from KRW 1.613 trillion in 2006. The e-learning supplier market volume, or e-learning sales in each area (solution, contents, service, etc.), was KRW 1.727 trillion in 2007, a 6.8 percent increase from KRW 1.618 trillion in 2006 (NIA 2008a).

OPEN SOURCE AND OPEN CONTENT INITIATIVES

Korea ranks high globally in all IT-related indexes except for software development where it is lagging. To create new markets and ultimately make the nation a software powerhouse, the government has been increasing demand for open source software (OSS) through large-scale public projects, and strengthening the production base of OSS through the revitalization of related communities.

Government efforts to encourage the use of OSS in the public sector boosted the growth of the OSS market from KRW

49 billion in 2002 to KRW 95.9 billion in 2006, representing an average annual growth rate of 18.3 percent. Linux has been used in building several administrative databases and it is now being adopted by the private sector, especially by dot-com companies like NHN Corporation (http://www.nhncorp.com, http://www.naver.com) and Daum Communications (http://www.daum.net). The desktop PC market is waiting for the release of a Linux PC with Asianux of Haansoft Corporation (http://www.haansoft.com) installed.

Linux adoption rates by firms and public organizations have been increasing steadily. As of 2006, public organizations showed the highest adoption rate (60 percent of the sector use OSS), followed by the distribution and service sector (35 percent), the financial sector (30 percent), and the manufacturing sector (23.8 percent). The average adoption rate was 40 percent, almost double the 19.6 percent adoption rate in 2005.

However, open source operating systems like Linux are not widely utilized in core servers, and Windows is the operating system of 98.9 percent of desktop PCs. Clearly, the share of OSS in corporate server and application markets needs to be increased. To eliminate prejudice against OSS, which is one reason why its use is not more widespread in Korea, the government has been focusing on developing OSS technologies and products, nurturing human resources, and documenting successful pilot cases and projects.

ICT RESEARCH AND DEVELOPMENT

The IT industry has a value chain structure that requires the organic harmony of three essential factors: service, infrastructure, and manufacturing capability. This perspective underpinned the release of the IT839 Strategy in February 2004. The strategy focused on eight core services, namely, high speed downlink packet access/wideband code division multiple access (HSDPA/WCDMA), Wireless Broadband (WiBro), broadband convergence service, digital multimedia broadcasting/digital multimedia broadcasting (DMB/DTV) service, u-home service, telematics/location-based service (LBS), radio frequency identification/ubiquitous sensor network (RFID/USN) service and IT service; three advanced infrastructure, namely, the broadband convergence network (BcN), USN, and soft infraware; and nine growth engines, namely, mobile/telematics devices, broadband/home network devices, digital TV/broadcasting devices, next-generation computing/peripheral devices, intelligent robots, IT SoC/convergence/parts, RFID/USN devices, embedded software (S/W) and digital content and S/W solutions.

The implementation of the IT839 Strategy has resulted in commercial success in several fields, and the u-IT839 Strategy is now being pursued as the Strategy's second phase (NIA 2007a).

In addition to strengthening the interfaces between and among the eight services, three infrastructure, and nine new growth engines, the focus on software policies has been enhanced.

The growth of the IT industry has recently been slowing down due to the market saturation and overheated competition. It needs a mutual-growth strategy, which aims to achieve growth through convergence with other industries such as manufacturing and service industries. Against this backdrop, the Korean government has formulated an IT convergence strategy that aims to apply IT in five major industries — automobiles, shipbuilding, construction, healthcare, and national defense — and to make them high value added industries. To push ahead with this strategy, the government will invest a total of KRW 1 trillion in developing IT convergence technologies by 2012. In 2008 KRW 70.6 billion has already been injected into the project.

For the auto industry, IT convergence technologies will provide a safe, convenient, and environment-friendly driving system, which should strengthen the industry's competitiveness. For the shipbuilding industry, technologies for design, production, and sailing will be integrated based on IT convergence technologies, creating high value added in the shipbuilding and marine industry. The government is also planning to promote the biomedical industry through the convergence of IT, nano-technology, and biotechnology. For the construction industry, the government aims to create an advanced construction environment by integrating the nation's traditional construction technology, construction materials, construction materials technology, construction logistics and process management technology, energy-saving and environment-friendly technology, construction-IT infrastructure technology, and intelligent technology. Finally, for the defense industry, the government will actively enhance informatization by using IT convergence technologies.

The Korean government is also pursuing efforts to develop green IT technologies, light emitting diode (LED) lamp, and u-healthcare. The goal is to use IT to address various social problems in the areas of environment, energy, aging population, and the like.

CHALLENGES AND OPPORTUNITIES

The anonymity that the Internet makes possible facilitates communication among people, but it also has adverse effects such as verbal violence and defamation in cyberspace. To prevent these adverse effects and encourage responsible behaviour on the Internet, the Act on the Promotion of Utilization of Information and Communication Network and Data Protection requires large private websites to include ways to track users by their national identity number.

Another social problem that has resulted from easy access to the Internet is Internet or online addiction. Internet addicts have difficulty controlling the amount of time they spend online, suffer withdrawal symptoms when away from the Internet, and are ultimately unable to engage in real life interaction and relationships. Internet addiction, which is also called pathological Internet use, is a problem that needs social attention because it can lead to criminal behaviour. In Korea, the K-Scale for the youth and A-Scale for adults have been developed to assess signs of Internet addiction. A 2006 study involving 3,000 people found that 9.2 percent of those sampled were Internet addicts. In response, public agencies, including KADO, have been providing people with education and counselling services to prevent and/or treat Internet addiction.

Meanwhile, as environmental pollution worsens, the environment is emerging as one of the biggest global issues. Global warming in particular is expected to have a serious impact on the global economy since an enormous amount of money is needed to fight global warming. In Korea, President Lee Myung-bak has suggested a national vision of 'Low Carbon, Green Growth' as the country's contribution to the international campaign to respond to climate change while maintaining economic growth. Green IT is grabbing much attention in Korea. Furthermore, a lot of research is being carried out on how to reduce the energy consumption and carbon emissions of the IT sector itself and how to use IT to improve energy efficiency and realize low-carbon economic growth.

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Lao People's Democratic Republic

Phonpasit **Phissamay**

Total population	5.62 million[a]
Rural population as a percentage of total population	69%
GDP per capita	USD 678[b]
Literacy rate	85%[a]
Teledensity	28%[b]
Telephone lines per 100 inhabitants	2.59[b]
Cellphone subscribers per 100 inhabitants	25.4[b]
Computers per 100 inhabitants	1.7[c]
Internet users per 100 inhabitants	1.77[d]
Internet hosts per 10,000 inhabitants	0.022%[c,d]
Internet cafes per 10,000 inhabitants	0.71%[d]
Number of websites in Lao languages	297[c]
Number of websites in English	660[c]
National transmission backbone	155 Mbps[c]
International bandwidth	1 Gbps[d]

(Sources: [a]Ministry of Planning and Cooperation 2007; [b]National Post and Telecom Authority 2007; [c]NAST 2007; [d]Lao National Internet Committee 2007)

OVERVIEW

Lao People's Democratic Republic (PDR) is a small, landlocked country in Indochina, with China, Cambodia, Vietnam, Myanmar, and Thailand as its neighbours. A large part of the country is mountainous and forested and the country has an abundance of natural resources. The majority (73 percent) of the country's 5.62 million people (as of 2005) live in the rural areas. About 40 percent of households have no access to electricity, almost 50 percent have access to electricity through the national grid, and another 10 percent use generators or car batteries to generate electricity.

Twenty-three percent of the population has never been to school and 47 percent have left school. About 30 percent of women, compared to about 16 percent of men, have never been to school. About 16 percent of students have completed primary school, 6 percent have completed lower secondary school, and 5 percent have completed upper secondary school. The literacy rate is 85 percent.

There have been positive gains in national development in Lao PDR with the implementation of the 2006–2007 Socio Economic Development Plan, the second Annual Plan under the 6th Five Year Plan (2006–2010). Policies supporting broader economic development have been extensively implemented, including reduction of the electricity tariff for irrigation. These policies have increased production, improved services, and enabled the monetary system to function more smoothly, thereby attracting more domestic and foreign investment. The Gross Domestic Product (GDP) in 2006–2007 increased

by 8 percent and the average GDP per capita reached LAK 6.56 million or USD 678. The economic structure is gradually being industrialized and modernized, with the share of agriculture-forestry decreasing from 43.5 percent of GDP in 2005–2006 to 40.9 percent of the GDP in 2006–2007, and the share of industry increasing from 30.5 percent to 33.1 percent. The share of the service sector remained the same at 26 percent of the GDP.

TECHNOLOGY INFRASTRUCTURE

Lao PDR does not yet have a National Information Infrastructure (NII), making planning and development difficult to coordinate. Telecom operators and Internet service providers (ISPs) build and use their own network infrastructure. There are five telecom operators and 12 ISPs. The number of telecom operators and ISPs has not changed since 2005 because new licences will not be issued until 2009.

Among the telecom operators, Enterprise Telecom of Laos (ETL) has installed the most extensive infrastructure: 3,969 kilometres of fibre optic cables throughout the country, 400 mobile base stations covering all 139 districts, 550 home location registers, 40 general portal radio service base stations, 450 intelligent networks to support the prepaid system, and 29,000 Public Switched Telephone Network (PSTN) lines with 39 sites serving four provinces. ETL also has fibre optic connections to China, Thailand, and Vietnam.

The Lao Asia Telecom Enterprise (LAT) has installed around 500 kilometres of fibre optic cable from the capital city Vientiane to the four provinces in the north. Eight provinces in the south are sharing the ETL fibre connection while the remaining three provinces are using very small aperture terminals (VSAT). The LAT has 173 Global System for Mobile communications (GSM) base stations covering 88 district offices. There are 10,000 PSTN lines in 17 sites serving seven provinces. The LAT also has a fibre optic connection to Vietnam.

The Lao Telecom Company (LTC) has installed around 1,000 kilometres of fibre optic cables connecting three provinces in the north and five provinces in the south. It has around 500 mobile base stations covering all 139 districts and 120,000 PSTN line capacities with 49 sites covering all 16 provinces of Laos. However, the LTC has only microwave and satellite connecting to Thailand. It operates the IPSTAR service, a broadband connection through satellite with a capacity of 250 Kbps to 2 Mbps.

The Lao Millicom Company (TIGO) is leasing fibre optic lines from ETL and LTC to connect to their mobile base station in the province, and it uses microwave for the interconnection of its mobile base station in Vientiane. Recently, TIGO introduced the Enhanced Data Rates for GSM Evolution (EDGE) system, which allows its mobile phone customers to connect to the Internet. The company is also installing Worldwide Interoperability for Microwave Access (WiMAX) base stations in Vientiane.

Lao Sky Telecom has invested around USD 5 million to establish a Code Division Multiple Access (CDMA) network in Vientiane, which it hopes to launch at the end of 2008. The company also has a fibre optic connection to Thailand.

Among the ISPs, it seems that only Planet Online Company has its own network infrastructure. It has set up a WiMAX hotspot in Vientiane and some provincial cities, and it is using the ETL and SKY gateway to connect to the Internet backbone. Planet is also planning to invest around USD 5 million to establish WiMAX base stations in Vientiane and three big provinces.

The government is building its own network infrastructure consisting of 100 kilometres of fibre optic cables to connect 130 government offices in Vientiane, 10 WiMAX base stations to connect 250 offices in Vientiane, and one WiMAX base station in each of 16 provinces to connect 160 offices (100 offices in one province) by the end of 2008.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

Under the National Authority for Science and Technology (NAST) established on 24 December 2007 is the Department of Information Technology, which is tasked with formulating and implementing IT policies and strategies.

The Department of Telecom and Internet, which is in charge of overall administration and development of telecoms and the Internet in Lao PDR, is under the National Post and Telecom Authority (NPTA) established on 22 October 2007.

The minister of Post and Telecom chairs the Lao National Internet Committee (LANIC), which is in charge of Internet management and development, including the operation of the national Internet gateway, Internet exchange point, and country code top level domain name. The committee's deputy chair is the vice-chair of the NAST and its members are the directors general of the Ministry of Defense, Ministry of Public Security, and Ministry of Information and Culture.

ICT AND ICT-RELATED INDUSTRIES

Currently there are 1,597,276 landline and mobile phone subscribers, or 28 telephone units per 100 persons. This teledensity indicates rapid growth, as it is much higher than the government target of 15 telephones per 100 persons. There are 145,857 PSTN subscribers, almost the same number as in 2006 (145,792 subscribers). But the number of GSM subscribers increased by 55 percent from 776,236 in 2006 to 1,401,419 in 2007, while the number of CDMA subscribers increased by 28 percent from 14,152 in 2006 to 50,000 in 2007. The rapid growth is due to the affordable price of mobile handsets from China, as well as the intense competition among mobile phone operators.

There are 1,283 dial-up Internet subscribers, 2,820 ADSL Internet subscribers, 198 satellite Internet subscribers (IPSTAR), and 33 leased line Internet subscribers. ETL also provides mobile Internet access via GPRS to around 20,000 customers. TIGO provides mobile Internet access via EDGE network to approximately 50,000 customers. Planet ISP provides Internet access via its wireless network in Vientiane to around 2,000 permanent customers.

There are around 400 Internet cafés in Vientiane and around 600 Internet cafés nationwide. Most Internet cafés have 10–20 PCs and cater mostly to young people who like to play online games and engage in online chatting. Some hotels, guesthouses, restaurants, and travel companies also provide Internet access as an additional service.

A 2007 government information and communication technology (ICT) survey of 25 government offices in Vientiane established a ratio of about two government offices per one computer. Sixteen ministry offices have set up a Local Area Network and 1,832 personal computers (PCs) are connected

to the Internet. Most of the ministries have Internet access via the national e-government infrastructure, with around 2,000 government staff accessing the Internet daily. Some ministries are almost totally computerized, such as the Bank of Lao headquarters with 300 PCs for around 350 employees (85 percent) and the Ministry of Foreign Affairs with 600 PCs for around 800 employees (75 percent). On the other hand, the Ministry of Public Security headquarters has only 60 PCs for 500 employees (12 percent) and the Ministry of Information and Culture has 155 PCs for 500 employees (31 percent).

Only 3 percent of companies (3,910 out of 126,913) use computers to enhance their business. The level of computer utilization also varies among different business sectors, with science and technology companies, education companies, electronic and electric companies, finance and accounting companies, construction companies, and service companies utilizing computers more than others. Agricultural companies use computers the least. Only 0.9 percent of companies has Internet access, while only 0.3 percent has a website.

Among NGOs, 3.8 percent (397 out of 10,434) use computers, 0.9 percent has Internet access, and 0.2 percent has a website. The academic institutions use ICT facilities. The National University of Laos (NUOL) has 1,000 PCs for 10,000 enrolees, while other technical colleges have three to five computer labs with 30 PCs in each lab. In primary schools there is very little use of ICT facilities, which are usually reserved for administrators and teachers' use only.

Out of the total 126,913 enterprises throughout the country, only 0.7 percent (872 entities) is engaged in ICT-related businesses. But the number of ICT-related businesses increased four-fold from 103 in 2000 to 513 companies in 2005. In 2006 196 new companies were registered. More and more ICT businesses are being set up and the total will probably reach more than 1,000 in 2008. Most of these businesses are small, with an investment of less than USD 10,000 in the case of computer retail and repair shops. Only 74 companies (8.4 percent) have an investment of more than USD 100,000. The biggest investors are the telecom operators, with an investment of more than USD five million each. The ISPs rank 2nd with an investment of more than USD 200,000.

The ICT companies employ 3,688 employees or 1.1 percent of the total work force in the country. The average is 4.2 persons per company, except for the telecoms operators, which employ more than 100 persons each, and the ISPs, which have more than 10 employees.

Most ICT companies are focused on the domestic market, with only four companies engaged in export. The main areas of business are computer reselling (both hardware and software),

training, consultation (solution and application), and service operators (telecom and Internet). There are currently no big investments in manufacturing and production due to the following reasons:

- While there are incentives for foreign investment, there are no specific incentives for local ICT companies. For example, the Department of Tax considers computers to be the same as television equipment, which is sometimes taxed up to 60 percent.
- The road and railway system is inadequate for transporting goods. In addition, the electric current fluctuates, causing damage to electronic equipment.
- There is lack of skilled labour. Few people have a background in electronics.
- The purchasing power of the local population is low. The average income is only USD 780 per year, while a computer costs between USD 500 and USD 2,000.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Recognizing ICT as an increasingly crucial tool for achieving socio-economic development, the Government of Lao PDR has recently endorsed the National ICT Policy submitted by the NAST. This policy document aims to ensure that the necessary institutional, human capacity, sectoral conditions, and legal frameworks are in place for leveraging and applying ICT as a means for helping Lao PDR advance from the status of least developed country (LDC) by 2020 through sustainable and equitable development.

The government aims to bring the country into the information age by increasing general access to ICT by providing modern telecommunications infrastructure and computer networks, fostering enterprise and industry, promoting research and development (R&D) in ICT, and developing the necessary human resources and institutional capacities. Accordingly, nine priority areas have been identified: infrastructure and access; enterprise and industry; R&D; applications; human resource development; legal framework; awareness; poverty alleviation; and standardization and localization.

The Department of Information Technology is developing the ICT Master Plan for 2008–2015. The ICT Master Plan will define overall ICT goals and strategies and it will be used as the basis for drawing up ICT sub-master plans for each ministry, as well as master plans for some key focus areas, such as an e-Government Master Plan, e-Commerce Master Plan, and e-Education Master Plan.

National e-Government Project

In November 2006, the government of Lao PDR allocated USD 35 million from a Chinese concession loan for the implementation of phase one of the National e-Government Project. The NAST has been authorized to cooperate with Alcatel Shanghai Bell Co., LTD in the two-year project implementation from November 2007 to November 2009.

The National e-Government Project aims to foster collaboration among government institutions to ensure efficient and effective delivery of public services and to enable the government to be more responsive to the needs of citizens and the business community. A special focus is making government services more accessible to citizens in the rural areas. The project has the following components:

1. Establish the e-government info-communication infrastructure consisting of:

   - An IP backbone with a 2.5 Gbps capacity to connect the national e-government centre to the telecom operators and some major ministries (i.e. the Prime Minister's Office, Ministry of Defense, Ministry of Finance, and Ministry of Public Security).
   - A fibre optic link to 50 ministries in Vientiane and ADSL cable connection for 75 other government offices.
   - 10 WiMAX base stations covering 20 square kilometres of Vientiane municipality and connecting to 250 government offices.
   - A fibre optic link to 16 provincial governor's offices and 16 e-government provincial centres.
   - One WiMAX base station in each provincial capital city to connect to 10 government offices in each province.

2. Acquire IT computing equipment for government organizations, including:

   - A National e-Government Centre with three computer training laboratories (with 30 PCs per lab), a network operation centre, and a national data centre.
   - An e-Government Provincial Centre in each of the 16 provinces to house a computer training room (with 10 PCs), an Internet room (10 PCs), a network room (for WiMAX), and some public service rooms.
   - IT facilities for each of the 126 ministry offices in Vientiane, including one server, 10 PCs, a teleconference room, and a local area network connected to the national e-government infrastructure.
   - IT facilities for the district and provincial department offices (200 offices) consisting of three PCs and one printer connected via a LAN and connected to the national e-government infrastructure.

3. Develop e-government applications that are appropriate, cost-effective, and based on standards of interoperability. The seven key applications under the National e-Government Project are the e-archive, e-register, e-document, e-map, e-learning and a teleconference system, and a national portal.

4. Enhance human resource development through training programs for ICT specialists, ICT engineers, content providers, and endusers. The targets are to train 40 ICT engineers, 300 ICT engineers from various ministries, and 1,500 government personnel from various organizations.

Rural Telecentres

The Information Technology Research Institute of the NAST, in collaboration with National Informatics Centre of India, has just set up 10 rural telecentres (RTCs) in seven provinces of Lao PDR. The RTCs are a means to utilize ICTs to raise the socioeconomic conditions of the people of Lao PDR, particularly those in remote areas along the Mekong River. Aside from connecting the rural communities to the rest of the country and the world, the RTCs should help the concerned provincial governments plan and implement ICT-supported citizen-centric applications.

One RTC was installed in each of Luang Prabang, Xayabury, Vientiane Province, Khammuane, Savannakhet, Saravane, and Champasack and three RTCs in the capital Vientiane (i.e. one RTC each at the Ministry of Public Health, Ministry of Agriculture, and Rural Development Authority Office). Each RTC is equipped with a server, five computers, a scanner, a laser printer, a Web camera, and broadband Internet connection.

To ensure the sustainable operation of the RTC, a Steering Committee and district implementation committee have been established. The Steering Committee consists of representatives of the NAST, Ministry of Agriculture, Ministry of Public Health, Rural Development Authority, and Office of the Provincial Governor. The RTC district implementation committee consists of the representative of the district governor's office, agriculture district office, health district office, and rural development district office. This committee will closely monitor the setting up of the RTCs. The district committee will also be responsible for evolving guidelines that will ensure the accessibility of the RTC to all citizens, promote the RTC in the community, and provide for the management of the village community portal, content management, and updating and maintenance to ensure the sustainable operation of the RTC. Appropriate training programmes will be conducted for RTC service providers and users. It is recognized that for the RTC to work for the people in the district, community-based ICT development should be implemented.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Existing laws and regulations in Lao PDR deal mainly with telecoms and the Internet. These laws include the Telecommunication Law of 2001, the Prime Minister's regulation for Internet users and service providers issued in 2000, a regulation by the Ministry of Information and Culture on Internet content issued in 2001, and a regulation of the Ministry of Public Security on Internet security and violence issued in 2002.

The Department of Information Technology has formulated a draft e-commerce law with assistance from the World Bank. Once passed, the law is expected to foster the growth of e-commerce and link Lao PDR to the region.

The Department of Telecommunication and Internet is formulating regulations in connection with the establishment of the national Internet Gateway. But some experts have suggested that one national gateway may limit Internet development in the country, and it will be difficult to ensure fair competition between those who will operate the gateway and those who will provide the service through the gateway.

There are plans to formulate and enact a legal framework against cybercrimes, a consumer protection act, and a legal framework to protect and encourage the creation of intellectual property.

DIGITAL CONTENT

As of the end of 2007, there were 106 websites registered under the domain name gov.la and 92 websites registered under the domain name com.la. The latter figure represents only 363 companies or 0.3 percent of the 126,913 companies with websites, because most of the companies would like to have websites with just a .com domain name as this is thought to be more international. There are 27 websites registered under the domain name org.la, 16 websites under net.la, 44 websites under edu.la, and 12 websites under info.la.

The biggest and most popular information providers are still the press organizations with daily online newspapers such as:

- www.vientianetimes.org.la — a government-owned newspaper in English;
- www.pasaxon.org.la — a government-owned newspaper in Lao;
- www.lerenovateur.org.la — a government-owned newspaper in French;
- www.lnr.org.la — the Lao National Radio providing content in Lao, English, French, and the Mong language;

- www.kpl.net.la — the state news agency providing daily news in both Lao and English; and
- www.vientianemai.net — a government-owned newspaper providing daily news in both Lao and English.

Other noteworthy websites are:

- www.health.gov.la — a bilingual (Lao and English) website on health-related information by the Ministry of Public Health with support from the World Bank under the Water and Sanitation Program.
- www.laotrade.gov.la — a bilingual (Lao and English) website to promote trade. It is supervised by the Ministry of Industry and Commerce.
- www.talad.gov.la — which provides information on market prices of agricultural products that farmers can use to determine where to sell their products, and which citizens can use to find out which market is selling a product that they need.
- www.sumson.gov.la — which contains information on the activities of the 10 RTCs. The website also provides information about community development, healthcare, agriculture, education, the environment, and the like.

However, in general, there is a need for more digital content in Lao PDR, and for regular updating of online content.

ONLINE SERVICE

It seems that the tourism sector is the most active provider of online services. The four- and five-star hotels have their own websites through which online reservations can be made, while tour and travel companies provide online booking services. Some handicraft shops and textile factories also provide online ordering services. However, there is as yet no online payment system in Lao PDR.

Under the National e-Government Project, government organizations are expected to provide for e-applications and the following online services are to be launched:

- e-Portal to provide a unique access point via the Internet to all government information and e-services. The e-portal will improve the existing national portal www.laopdr.gov.la.
- e-Registration, a Web-based application in both Lao and English. In the first phase, each organization will design its own template for citizens to fill in and submit online via the organization's website. The second phase will focus on providing for interaction and integration solutions.
- e-Documents system, which consists of two components: establishing the information management system and

instituting a system for use of electronic signatures and system verification.

- e-Map for storing and managing maps and statistical data.

The Ministry of Finance is also developing the e-revenue system and the Ministry of Foreign Affairs is developing the e-visa system.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAM

The government is highly committed to improving the IT capability of employees. The present approach is 'Training the Trainers' whereby a selected number of officers undergo training in computer-related courses, and they in turn are expected to train their colleagues.

ICT education is highlighted in the National ICT Policy in terms of the following goals:

- Development of a world-class curriculum for Bachelor and Master's degrees in computer science/engineering and other ICT-related degrees;
- Promotion of the integration and teaching of Free and Open Source Software (FOSS) in computer science/engineering curricula;
- Application of ICT in the Ministry of Education's five main programs: *(i)* pre-school and general education; *(ii)* non-formal education; *(iii)* teacher training; *(iv)* vocational and higher education; and *(v)* administration and management;
- Provision of computer labs and Internet connectivity at all levels of the education system, beginning at the higher levels of education and leading to the integration of ICT in the teaching and learning process in all schools;
- Provision of the infrastructure necessary for school administration and for ICT training in teacher retraining programs;
- Re-training for civil servants;
- Promotion of lifelong learning and e-education or distance education;
- Establishment of a certification and accreditation system to ensure high standards of education and training; and
- In the rural and remote areas, piloting of telecentre programs to ensure opportunities for ICT-enabled learning for the most underserved and those without ready access to education.

The NUOL is the main institution tasked with developing human resources for the ICT field. The NUOL Department of IT and Computers is offering a five-year Bachelor's degree in IT that has produced around 50 computer programmers every year since 2003. The Department of Electronic and Telecommunication Engineering offers special IT courses, such as an IT bridging course for those who have already obtained a diploma in other engineering specializations. The IT bridging course has graduated around 40 computer engineers annually since 2005. However, the number of IT graduates is still very low relative to the demand for skilled personnel. For example, the National e-Government Project requires 300 computer network and hardware engineers and 600 computer application engineers for 2007–2009.

Foreign assistance is being provided to enable Lao students to study ICT-related fields abroad. The government of India has a scholarship for 30 Lao students to complete a Master of Computer Applications program in India for a period of three years (2006–2008). The government of Australia has been providing undergraduate and graduate scholarships in ICT programs since 2000 to two persons per year. The number of scholars was increased to six in 2007 and then to 10 in 2008. The Government of Japan has been providing undergraduate and graduate ICT education scholarships since 2002 to five persons per year. The Association of Southeast Asian Nations (ASEAN), Canada, China, the EU, and the US also provide ICT education scholarships to one or two persons per year.

In general, it is necessary for Lao PDR to have an ICT human resource development master plan at the national level that includes both formal and non-formal ICT education, skills required for the traditional and the new economy, youth and women empowerment, and distance education. Therefore the NAST, together with the Ministry of Education, is now formulating an ICT human resources master plan that highlights the following:

For formal education:

- Establishing an education network as part of the NII to provide educational services and learning opportunities to all;
- Promoting e-learning to supplement the education and learning opportunities in the provinces;
- Review and strengthening of computer-related subjects in school curricula;
- Computer training for schoolteachers; and
- Provision of school information infrastructure, including a telecommunication network, computer facilities, stable electricity, basic educational software and content, and Internet access.

For non-formal education:

- Using ICT to upgrade workers, unemployed youth, and women;
- e-Learning for lifelong learning; and
- Development of ICT professionals and re-training of the existing workforce in ICT

For higher education:

- Establishing a higher education institute specializing in ICT and software engineering;
- Helping government agencies set up their management information systems as well as agency-specific software systems;
- Acquiring and producing educational software and digital content;
- Conducting R&D in ICT applications for distance learning;
- Encouraging private sector participation in computer training programs in schools;
- Promoting a voluntary support system to assist schools in ICT integration; and
- Making necessary arrangements for data compatibility and standards.

ICT RESEARCH AND DEVELOPMENT

In December 2007, the Lao government established the Information Technology Research Institute under the NAST to guide the country's ICT research, development, training, promotion, and service agenda. The Institute has three main centres conducting ICT-related research. The Network Centre is responsible for the construction, development, and operation of the national e-government infrastructure, government Internet access, and the country code top-level domain name. The Network Centre also conducts research on network security and public key infrastructure. The Research, Development and Training Centre is responsible for technology transfer and dissemination of technology applications to society. It focuses on Lao localization, e-government applications, e-learning applications, and ICT skills testing and accreditation. The National Data Centre is responsible for the construction, development and operation of the national portal, e-government service centre, and community telecentres. Its main research focus is building e-content with system security.

The IT Research Institute evolved from the IT Centre whose capacity in R&D was developed through its four-year involvement (from 2003 to 2006) in the PAN Localization Project supported by International Development Research Centre (IDRC) of Canada. The Project enabled IT Centre staff to undergo technical training and undertake joint or collaborative research with other countries implementing it. The key outcomes of the PAN Localization Project for Laos are the following:

- Systematic study of the Lao language structure
- Development of tools and utilities to enhance IT in Lao, such as Lao fonts, Lao keyboard drivers, Lao ASCII to Unicode

converters, Lao line breaking utility, Lao sorting utility, Laopad (a localized version of Note Pad), and Lao OCR
- Research papers on Lao language information processing
- Research products such as free publication of research software on CD-ROMs and the project website (www.laol10n.info.la)
- Various workshops and seminars
- The transfer of technical know-how to many students and other local developers through various technical training programs and the project work itself
- Extensive practice in collaborative R&D

The NUOL is also conducting various research activities on such topics as problems of meteorological characteristics and communication reception in Laos; the relationship between broadcasting signals and rain characteristics in Laos; the design of the transmission line simulator, a pattern recognition approach to segmentation with application to continuous Lao recognition, online freestyle handwritten Lao character recognition using feature tree; and a QoS-based routing algorithm with crank-back ability.

OPEN SOURCE INITIATIVES

Interest in open source is increasing slowly in Lao PDR. The open source movement in the country was started by Anousak Souphavanh, a Lao programmer who has worked on localizing OpenOffice and Linux, Mozilla products, Unicode font, keyboard drivers, and others.

The NAST is undertaking work on Ubuntu and Suse, GNOME Desktop, KDE Desktop, Debian as Kernel OS, Open Office.org applications, Mozilla's Thunderbird and Firefox, Joomla and Drupal as CMS Web commerce applications, Quantum Geographic Information System (QGIS) and other open source applications. It also held a workshop on open source in March 2008.

Lao open source advocates collaborate in regional software localization efforts and cooperate with universities to support localization. Translating open source software to Lao is a particularly important endeavour.

CHALLENGES AND OPPORTUNITIES

It is now relatively easier for Lao people to have access to computers and the Internet. Local businesses are using computers and the Internet not only to find information but also

Schoolnet Program

In July 2007–July 2008, US-based non-government organization (NGO) World Links for Development, Jhai Foundation, and the Lao Ministry of Education agreed to implement the World Links Program in Lao PDR as part of a World Bank–Japan Social Development Fund ASEAN SchoolNet Project Grant. The overall goal of the program was to provide selected secondary schools and the Ministry of Education with sustainable solutions for mobilizing necessary technologies, skills, and educational resources to prepare students and teachers to enter the Information Age.

The program set up computer labs with Internet connections in 10 secondary schools. Training workshops in computer literacy and teaching and learning with computers and the Internet were held for 30 teachers of various subject areas (e.g. mathematics, science, history) from the 10 schools.

(Source: Ministry of Education 2007)

to find more business opportunities (i.e. clients, suppliers, and business partners). Because of the improved telecommunication infrastructure that allows for a reliable Internet connection, some business organizations can host their own websites and email servers and manage their own information systems. Some end users in Laos also have experience in online shopping and they want to set up online stores.

The government of Lao PDR is aware of the role of ICT in industrialization and modernization, as well as in improving the quality of government service and administration. This is why it is undertaking the National e-Government Project.

However, Lao PDR needs to build the necessary national information infrastructure, increase investment in the ICT sector, develop skilled human resources, and engage in more IT R&D. Private investment in the country is currently confined to telecom services and IT training. The production of low-technology IT goods like IT entertainment goods, IT components like passive and electro-mechanical components, and IT enabled services is worth exploring. There is also a need to develop the public's awareness and understanding of the role of ICT in development. Awareness programs for various sectors should be considered.

An adequate supply of trained human resources is needed not only to generate locally relevant content and ensure effective use of ICTs, but also to enable the country to participate in IT-enabled services. For this reason, a greater investment in IT human resource development in Lao PDR is vital.

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Macau

Luiz Gonzaga **Lau** and Luis Chi Meng **Loi**

OVERVIEW

Information and communication technology (ICT) plays an important role in the economic, political, social, and cultural life of the Macau Special Administrative Region (MSAR) of China. This can be seen from the fact that there are more mobile phones in Macau than there are people (794,323 mobile phones for a population of 531,400), and about a fifth of the population (119,913) is subscribed to the Internet. An automatic passenger clearance system for smart identity (ID) card holders at Macau's border gate checkpoint has been in place since 2006, speeding up clearing time for the 27 million visitors to Macau in 2007.

Policies and updated news from the government are posted at official websites for general public access and most of the notification regarding social services is now disseminated through websites, email, and short message system (SMS). Furthermore, Macau's first certification service provider called eSignTrust, which is accredited by the MSAR government and managed by the Macao Post in accordance with the Electronic Documents and Signatures Law (EDS Law, Law No. 5/2005 of MSAR), has been promoting the use of electronic certificates.

TECHNOLOGY INFRASTRUCTURE

The first Global System for Mobile Communication (GSM) digital mobile service in Macau, Internet services, and the Guangdong–Zhuhai–Macau Synchronous Data Hierarchy (SDH) 622 Mbps Transmission System were launched in 1995. Two years later, the Integrated Service Data Network (ISDN) service and a series of value added services (VAS) were launched and the connection of the South East Asia–Middle East–West Europe–3 (SEA–ME–WE–3) submarine cable to Macau's Landing Point was realized.

In 1999, the public telecommunications concession was renewed to 2011 and all analogue mobile telephone networks were terminated. Internet broadband service was launched in 2000 and the Plesiochronous Digital Hierarchy (PDH) Microwave Links to Hong Kong were replaced by SDH Microwave Links a year later. Mobile telephone services have been liberalized and number portability has been launched.

Commercial wireless broadband service was launched in 2005 and 3G mobile telephone service two years later. The fibre network and radio systems carry voice and data traffic across the territory.

Apart from mobile and Internet services, all public telecommunication lines are still provided by the Companhia de Telecomunicações de Macau (CTM) under a monopoly concession, which has resulted in relatively high prices. Furthermore, interconnect lines between operators and international lines increase the operating cost.

To receive terrestrial television signals from Hong Kong and mainland China, several antenna service providers installed antennae up in the hills and relay the TV signals with boosters spaced at intervals through TV cables across buildings. Although these providers have never been licensed, most households have been using these illegal services for some 20 years now. This is also despite the establishment of Macau Cable TV, Limited (MCTV) in 2000 as the only paid service television (TV) company in Macau with a concession contract until 2015.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The key organizations dealing with ICT in the government sector are Direcção dos Serviços de Administração e Função Pública (SAFP — Public Administration and Civil Service Bureau) and Direcção dos Serviços de Regulação de Telecomunicações (DSRT — Bureau of Telecommunications Regulation).

The SAFP was formally established in 1994 to modernize communications, provide technical assistance, and ensure a reliable and secure information flow between governmental departments. The SAFP is also one of the pioneers in e-government development in Macau.

In 2000, one of the key functions of the Direcção dos Serviços de Correios, Telefonicos e Tegraphicos de Macau (CTT — Telephony and Telegraphy Bureau) in telecommunications was transferred to a newly established office called Gabinete para o Desenvolvimento das Telecomunicações e Tecnologias da Informação (GDTTI — Office for the Development of Telecommunications and Information Technology). This was eventually transformed to the DSRT in 2006. As its name implies, the DSRT is the regulatory body for all public telecommunications in Macau.

In addition, there are key ICT-related committees directly under the supervision of the Macau chief executive. They are: the Macau Foundation (FMAC), the Science and Technology Committee (CCT), and the Science and Technology Development Fund (FDCT). The FMAC was established in 2001 to promote activities related to science and technology. The CCT was established in 2002 as a consultative body to advise the MSAR government on the formulation of policies to promote technological development and modernization. The CCT can also freely establish ad hoc committees to meet its overall mission. The committee members are appointed by the chief executive. Nine internationally renowned scholars are also appointed as advisors to the committee.

Established in 2004, the FDCT (www.fdct.gov.mo) subsidizes the development of educational programs, research, and other related projects to promote and enhance science and technology knowledge, improve productivity and competitiveness, facilitate development through innovative projects, and enhance socio-economic development of high-priority technology-transfer projects as well as patent applications. Eligible to receive the FDCT subsidies are local universities, academies, affiliated research and development (R&D) centres, local non-profit private organizations, laboratories and entities, registered entrepreneurs, enterprises, and individuals involved in development projects.

Two non-profit institutions devoted to scientific research, technological development, technology transfer, and training in ICT and electronics are the United Nations University — International Institute for Software Development (UNU-IIST) and Instituto de Engenharia de Sistemas e Computadores de Macau (INESC — Institute of Engineering Systems and Computers).

Innovative programs in ICT are provided by the University of Macau (UMAC), which is owned by the MSAR government; the University of Science and Technology, a private university; and the Instituto de Inter-universitário de Macau (IIUM — Macau Inter-University Institute), a private Catholic university.

The Cyberlab of the Centro de Produtividade e Transferência de Tecnologia de Macau (CPTTM — Macau Productivity and Technology Transfer Center) offers a variety of ICT training, support, and certification services for adult lifelong learning, whereas Direcção dos Serviços de Educação e Juventude (DSEJ — Education and Youth Affairs Bureau) oversees kindergarten, primary, and secondary schools.

In the private sector, all of the mobile operators, namely, CTM, Hutchison Telephone (Macau) Company Limited, Smartone Mobile Communications Limited, and China Unicom (Macau) Limited, play an important role in ICT projects. Kong Seng Paging Limited is a private company that is heavily involved in ICT projects in Mainland China.

Teledifusão de Macau S.A. (TDM — Macao TV Broadcasting Co.) was established in 1988 with the Macau government as the major shareholder. It has one Chinese and one Portuguese channel, and it provides free television and radio broadcast services. Radio Macao, a subsidiary of TDM, also has one Chinese and one Portuguese channel. Both share the same website (www.tdm.com.mo). In addition, there is one commercial radio station called Green Village.

MCTV is the only paid service television company in Macau. It offers 70 different channels from around the globe through digital transmission and reception systems. Advanced technology is used in digital transmission to broadcast television programs. Specifically, satellite signals of different programs are sent to the satellite receiver situated in Coloane and then converted into digital signals under MPEG-2 DVB technology. MPEG-2 DVB can avoid the detrimental effects of climate changes, guaranteeing the delivery of high-quality and high-speed television signals. The satellite signals deciphered in Coloane are transmitted to the lighthouse of Guia Mountain through fibre optics, and then relayed throughout Macau by microwave.

The Macao Communications Museum was officially inaugurated in 2006 as part of the Macao Post. The museum seeks to stimulate public interest, particularly among school children, in the scientific and technical aspects of telecommunications. The exhibits allow visitors to understand the evolution of the

means and techniques of communications as well as the front-end technologies.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Technical support from Mainland China is one of the considerations in the formulation of ICT policies in Macau. In particular, the Science and Technology Committee studies the integration of regional technological capabilities to adopt the appropriate focus and approach to technology development in the territory. The main focus at present is education and training programs for schools and the community to popularize science and technology and improve science and technology literacy. The approach taken is to allocate funding to install and upgrade hardware in schools, and assign IT staff to help those in need of assistance for further development.

A related initiative is the construction of the Macao Science Centre close to the Macau Cultural Centre, to provide youngsters with a friendly environment where they can broaden their minds and gain more knowledge of cutting-edge technologies that drive the world today.

The computerized Central Library complex is another key ICT initiative. Since August 2007, the Central Library has been providing one hour of free wireless Internet access to visitors with laptops to cope with the increasing demand for the use of the library computers. In January 2008, the coverage and use of free Internet access was expanded.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The MSAR government is strongly committed to the protection of intellectual property rights (IPR). It has sought to adopt the best IPR regime in line with international standards and it has strengthened laws to fortify IPR enforcement particularly against piracy.

Recognizing that combating money laundering and the financing of terrorism are essential to sustainable development, the MSAR government campaigned for the passing of the Anti-Money Laundering Law and the Anti-Terrorism Law in 2007. The laws provide for the establishment of a trans-departmental anti-money laundering coordination and working unit and a financial intelligence office, respectively. A supervisory body to ensure the enforcement of the two new laws is now in place.

The Office for Personal Data Protection (GPDP, www.gpdp. gov.mo) was also established in 2007. One of the GPDP's most recent issuances is the 'Principles concerning the protection of personal data in the workplace: Guidelines for employee monitoring'.

DIGITAL CONTENT

A brand new interactive website for the Macau Grand Prix (at http://www.macau.grandprix.gov.mo) was officially launched in September 2007 to provide motorsport fans with access to comprehensive information and the latest news from the Macau Grand Prix (MGP). According to the MGP committee, the new website is designed for visitors of all ages; it is both informative and entertaining, with a photo gallery, the latest news, as well as links to a range of international motor-sport events and Macau-related websites. Visitors may access previous races through archive film footage, and get background information such as a Guia Circuit map, how the circuit corners got their names, and circuit flag signals. During the 54th Macau Grand Prix in 2007, results, race reports, and images were posted throughout the event. The site is available in traditional and simplified Chinese and in Portuguese and English.

In 2007, the Macau Government Tourist Office (MGTO) in cooperation with the University of Macau (UMAC) released the popular MacauMap handheld tourist guide system for smart mobile phones. MacauMap has functions like map viewing, navigation, searching for streets, display of information in Chinese and English, a bus guide, and a restaurant and hotel guide. According to the MGTO, MacauMap provides information on popular walking tours of Macau, including a slideshow of scenes along each of these tours. The previous version won several awards for its innovative and high quality tourist-oriented functions, including the first prize at the 2004 Macau Information and Communication Technology Awards and the grand prize in the Tourism and Hospitality Category of the 2004 Asia Pacific Information and Communication Technology Awards.

The first sign-language educational video compact disc (VCD) was launched in early 2007. The VCD features not only vocabulary, but also the unique lifestyle of deaf persons in Macau. The VCD, which is suitable for beginning learners of sign language, was produced to educate the public on how to communicate with deaf persons as part of a wider plan to enable deaf persons to enter the Macau workforce.

ONLINE SERVICES

The MSAR government portal (www.gov.mo) was officially launched in 2004 as the comprehensive platform by which the public can access information and e-services from all

government departments. The portal provides information in the official languages of Chinese and Portuguese, as well as in English. It contains government information, news and announcements, city information, cultural and recreational activities, e-services, legal advice, and an interface for registering comments and complaints.

To facilitate the formulation and implementation of macroeconomic policies and private investment decisions, the MSAR government joined the General Data Dissemination System (GDDS) of the International Monetary Fund (IMF) last August 2007. The GDDS regularly disseminates comprehensive economic, financial, and social statistics aligned with international statistical standards to the international community. The Dissemination Standards Bulletin Board for Macau is available at http://dsbb.imf.org/Applications/web/gdds/gddscountrycategorylist/?strcode=MAC.

Another recently implemented e-service is a traffic fine record system that traffic violators can check to settle their traffic fines within 15 days from the date of offence. This is part of the Road Traffic Law that took effect in October 2007 the implementation of which involves the Public Security Police Force, Land, Public Works and Transport Bureau, Legal Affairs Bureau, and Civic and Municipal Affairs Bureau.

During the winter and early spring, the level of salt in Macau's tap water reaches a record of 500 parts per million. In late 2006 the MSAR government formed a Salinity Response Task Force to discuss measures to tackle the seasonal increase in salinity of the water supply. Among other measures, a four-level 'Salinity Scale for Potable Water' distinguished by colours is made available to the public on a daily basis via the mass media and the Internet.

The MSAR government continues to improve social welfare and social security by providing greater assistance to disadvantaged members of society, promoting the concept of sustainability in social welfare to create a healthy city with healthcare for all, and promoting disease control and prevention in the entire community through the mass media and the Internet.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

Based on the 'Fundamental Law of the Non-tertiary Education System', the MSAR government has been investing more in non-tertiary educational resources. Providing ICT-related equipment and connectivity, such as more powerful desktop computers and servers, wireless and fibre campuses, and a projector per classroom, constitutes a large part of the investment.

According to statistics from the Education and Youth Affairs Bureau, there were 86,821 students in formal education and 3,673 students in recurrent education in academic year 2007–2008. The total enrolment was 2.3 percent higher than total enrolment in the previous year. There were 5,100 teacher in 2007–2008, up 6.03 percent from 2006–2007 and making for an improved teacher–student ratio of 1:17.7 compared to the previous year's 1:18.3. The MSAR government is equipping elementary schools with various hardware and software and providing teachers with professional training that would enable them to teach and act as life mentors, promote holistic development of young people, advocate patriotic education about the motherland and Macau, and create a space for young people to demonstrate their abilities and creativity.

According to the MSAR government, the Education Development Fund will provide more resources to help schools improve campus environments and facilities, improve the quality of teaching materials, and facilitate curricular reforms. The latter is envisioned to include small-class teaching, nurturing students whose academic results are outstanding, and providing ordinary students with opportunities to accumulate experience and unlock their potential for successful careers in different industries. Incentive programs are being laid to improve school management and training programs for teachers. In addition, a new student loan scheme that does not impose restrictions in terms of family income is now available.

However, there is a shortage of ICT personnel in Macau, which puts schools at a disadvantage. Because the wages of

Macau Memory Project Lacks Skilled Personnel

The Macau Memory Project (MMP) and Macau Document Information Resource Database (MDIRD) are the core themes of the platform that is used to consolidate and preserve valuable historical information about the Macau culture. The project includes information from the databases of all libraries and organizations, as well as valuable scientific information on Macau on the Internet. The objective is to give the public fast and effective access to up-to-date information to improve the capability and competitiveness of scientific research in Macau. However, the project has been slowed by lack of skilled staff to collect and input the information.

school ICT personnel are lower and the scope of work much narrower than in the private sector, most of the experienced ICT personnel move to the private sector, leaving the schools with less-experienced ICT staff. This in turn affects the quality of ICT teaching and use (see 'Macau Memory Project Lacks Skilled Personnel').

OPEN SOURCE/OPEN CONTENT INITIATIVES

The MSAR government has been promoting the use of open source software and platforms in line with the emphasis on IPR protection. In this connection, the CPTTM has been offering a wide range of Linux courses such as Linux Fundamentals, Linux Network and Security Administration, Linux System Administration, and Linux Administrator Diploma Program. The courses aim to develop network servers who can configure and maintain a Linux system. Linux is widely used by small and medium-sized enterprises in Macau.

Another initiative in open source is use of Web-based JAVA and ASP.NET programming in conjunction with Structured Query Language (SQL) or Oracle database by a group of ICT personnel. They share scripts to be used in different areas of business such as human resource management, attendance record, payroll system, inventory control, and point-of-sale applications. An enterprise resource planning platform across offices and branches is being studied.

ICT RESEARCH AND DEVELOPMENT

The FDCT sponsors the ICT projects of various institutions. One of these was a project by Chipidea Microelectronics called 'full high definition, multi-format video analog front-end intellectual property in 65nm CMOS' that was completed in January 2008. Complementary Metal Oxide Semiconductor (CMOS) is widely used in electronic appliances. The newly developed product has a low voltage of 1.2 volt and low power.

The Portuguese/Chinese Bi-directional Translation System (PCT) is a project that aims to develop a software system for translating Portuguese and Chinese documents bi-directionally (see 'A Bi-directionaly Translation System').

To achieve sustainable development and improve the quality of life of Macau residents, the MSAR government has been promoting a more diversified industry portfolio. A Research Centre for Sustainable Development Strategies was set up in 2006 to help formulate policies and strategies for sustainable development. One of its key focus areas is ICT.

CHALLENGES AND OPPORTUNITIES

Macau has been experiencing rapid economic and social growth in recent years. But its greatest challenge is the shortage of skilled human resources. This has become a bottleneck for sustainable development. The MSAR government has increased efforts to upgrade the skills of local employees, including helping middle-aged residents with a poor educational background to attend suitable job-transfer training and improving the job matching assistance. Still the structural unemployment and lack of ICT expertise remains unresolved.

Encouraging more professional ICT personnel abroad to work in Macau seems inevitable for the sustainable development of ICT in the territory. However, the increasing number of overseas employees has caused concern among local workers and deepened social conflicts. The MSAR government seeks to balance the interests of all parties while ensuring that the local citizens' employment rights are given first priority.

The tax received from the gaming industry has resulted in an income surplus that the MSAR government invests in ICT education as well as in development funds. Although there are uncertainties and conflicts of interest, the opportunities for the development of ICT hardware and software are enormous given the support of the MSAR government.

As the concession contract of CTM will expire in 2011, the MSAR government will have to decide whether the local fixed

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A Bi-directional Translation System

The Portuguese/Chinese Bi-directional Translation System (PCT, http://www.inesc-macau.org.mo/pct/) aims to make documents in Portuguese and Chinese equally accessible in various media (i.e. text editor and the Web). The system provides pronunciation in Portuguese, Mandarin, and Cantonese using voice synthesis technology. According to the Institute of Computer and System Engineering, which developed the system, the pronunciation function, stability and accuracy of mouse tracking, and dictionary content have been improved for compatibility with the Microsoft Windows environment in English.

The PCT is available for free download. Many Portuguese and Chinese learners, as well as university students studying translation, use it frequently.

line and international services and leased lines are to be liberalized to encourage benign competition. If it opts for liberalization, many business opportunities will be created for foreign investors and manufacturers.

The concession of MCTV will expire in 2015. In the meantime there are eight antenna service providers illegally providing TV signals to the majority of households. This problem has remained unresolved for over two decades. It will be a great challenge for the MSAR government and the 'illegal' service providers as well as MCTV to arrive at a compromise given the number of households benefiting from the illegal service. Some solutions suggested by the community include revoking the MCTV concession to create fair competition, cutting off or disconnecting the illegal antenna service, and having the antenna service providers provide signals to MCTV. The DSRT needs to take the initiative to resolve the issue.

The lack of sophisticated ICT research centres in Macau prevents further development of high-tech ICT projects. It may however be possible to attract renowned scientific and research centres to set up a branch in Macau, thus providing an important opportunity for the internationalization of ICT development in Macau.

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Malaysia

Musa **Abu Hassan** and Siti Zobidah **Omar**[1]

Total population	27.46 (2008)[a]
Literacy rate	Male = 92%; female = 90% (2008)[a]
GDP per capita (in USD)	USD 7,000 (USD 1= MYR 3.147)[a]
Computers per 100 inhabitants	21.8 (October 2005)[f]
Mobile phone subscribers per 100 inhabitants	85.1 (2007)[e]
Internet users per 100 inhabitants	14.3 (2007)[e]
Domain names registered under .my	78.618 (as of October 2008)[f]
Broadband subscribers per 100 inhabitants	7 (2008)[b]
Internet domestic bandwidth	3.6 Mbps (September 2008)[e]
Internet international bandwidth	3.6 Mbps (September 2008)

(Sources: [a]Malaysian Statistics Department 2008; [b]Bank Negara Malaysia [Central Bank of Malaysia] 2008; [c]Aziz 2008; [d]Abu Hassan and Hasim 2008; [e]MCMC 2008; [f] MYNIC Berhad 2008)

INTRODUCTION

Since gaining independence from the British in 1957, Malaysia has embarked on various development projects to accelerate the country's growth. In recent years, information and communication technology (ICT) has been a major component of the country's five-year development plans. The five-year development plans in the 1970s sought to create balanced development within states in Malaysia and to reduce disparities between rural and urban areas. The development of ICT at the global level has prompted the Malaysian government to strengthen the role of ICT in national economic development.

Various institutes have been set up in support of ICT development. For instance, the Malaysian Institute of Microelectronic Systems (MIMOS) was established in 1985 with the aim of providing critical infrastructure for the advancement of the local electronic industry (MIMOS 2008). Vision 2020, a plan to achieve developed country status for Malaysia by the year 2020, was launched in February 1991 by then Prime Minister Tun Dr Mahathir Mohamed in a speech entitled 'Malaysia: The Way Forward' at the Malaysian Business Council (Economic Planning Unit 1991). Under the 7th Malaysia Plan 1996–2000, the National Information Technology Council (NITC) was established as an advisor to the government on IT development. The government likewise launched the Multimedia Super Corridor (MSC) during this development period. The National Information Technology Agenda (NITA) was adopted soon thereafter to guide IT development in the country (Abu Hassan and Hasim 2008).

The 8th Malaysia Plan 2001–2005 aimed to provide a stronger platform for the country's transition toward a knowledge-based economy. In the 9th Malaysia Plan 2006–2010, the focus is on advancements in the global digital environment and promoting wider ICT adoption and usage in all aspects of everyday life. This chapter provides an overview of some of the efforts in this regard.

TECHNOLOGY INFRASTRUCTURE

Under the 9th Malaysia Plan a budget of MYR 12.88 billion (about USD 3.55; 1 USD = MYR 3.147) has been allocated for ICT-related programs. This represents a 64 percent increase from the MYR 7.88 billion budgetary allocation for ICT-related programs during the 8th Malaysia Plan (Economic Planning Unit 2006).

A centrepiece program in technology development in Malaysia is the Multimedia Super Corridor (MSC), designed to create an ideal environment for ICT-related production and provide the backbone for an information superhighway. The network contains a high-speed link that connects Malaysia to other countries in the Association of Southeast Asian Nations (ASEAN), Europe, Japan, and the United States (US), and is capable of supporting extensive public administration, education, and business applications. In other words, the superhighway is intended to provide Malaysians with fast and reliable access to global information.

The government's efforts to improve access to ICT are connecting more citizens. Statistics show that there were 2,851,000 fixed-line residential telephone subscribers (47.8 percent of households) and 1,499,000 fixed-line business subscribers in 2007 (MCMC 2008). Similarly, the cellular phone penetration rate increased to 85.1 per 100 inhabitants at

the end of 2007, with 23,347,000 cellular phone users in the country. Internet dial-up subscriptions also increased to 14.3 per 100 inhabitants in 2007 compared to 13.9 per 100 inhabitants in 2006. The broadband subscription in 2007 was five per 100 inhabitants (MCMC 2008). The personal computer penetration rate in 2005 was recorded at 21.8 per 100 inhabitants (Economic Planning Unit 2006).

To develop technology infrastructure, Malaysia has launched a five-year ICT master plan called Malaysian Information, Communication and Multimedia Services 886 Strategy (MyICMS 886). The plan aims to deliver, in the 2006–2010 period, advanced information, communication, and multimedia services. The plan consists of eight new services to catalyze and promote the development of eight essential infrastructure for consumers and businesses in Malaysia to generate growth in six areas (ITU 2006). The eight new services are high speed broadband, third generation (3G), mobile TV, digital multimedia broadcasting, digital home, short range communication, Voice over Internet Protocol (VoIP)/Internet telephony, and universal service provision. The eight essential infrastructures are multi-service convergence networks, 3G cellular networks, satellite networks, next-generation Internet protocol (IPv6), home Internet adoption, information and network security, competence development, and product design and manufacturing. The six areas that will generate growth are content development, an ICT education hub, digital multimedia receivers, communication devices, embedded component devices, and foreign ventures.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

Twenty-six ministries and the prime minister's department are expected to utilize ICT to the fullest in delivering services to their target sectors (Abu Hassan and Hasim 2008). Several government organizations are specifically tasked with ICT development in Malaysia:

- The Ministry of Energy, Water and Communication (MEWC) is responsible for policy and strategic planning for the communications industry, coordinating policy implementation, and monitoring industry performance.
- The Ministry of Information is responsible for public information dissemination through the electronic media, face-to-face communications, and film making activities. There are four agencies under the ministry: the Department of Broadcasting, Department of Information, Department of National Film, and Department of Special Affairs.
- The Ministry of Home Affairs is responsible for film control to safeguard racial harmony in accordance with the principles of *Rukunegara* (the Malaysian National Principles).

- The Ministry of Science, Technology, and Innovation (MOSTI) provides technical and management support services to ICT projects and programs.
- The Ministry of Rural and Regional Development is in charge of community access, telecentres, rural information programmes, bridging the digital divide, and village information center (Infodesa) projects for computer training skills and computer literacy.
- The Malaysian Communications and Multimedia Commission (MCMC), which is under the MEWC, issues telecoms licences, implements regulations, and facilitates universal service provision.
- The Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) is tasked with enhancing the quality, efficiency, effectiveness, and integrity of the Malaysian Civil Service. This includes overseeing ICT development, in addition to organizational development, management integrity, and enhancing the relationship between the public and private sectors.

Every state government also plays an important role in promoting use of ICT particularly by providing community access to the State Information Technology Advancement Unit (KIT) for Electronic Government System, education network, and electronic commerce. The local authorities of city councils are also responsible for providing community access to the Internet, as well as computer skills training and computer literacy.

In the private sector, cybercafé entrepreneurs play an important role in Malaysian ICT development by providing communities with access to the Internet and the digital experience (Abu Hassan and Hasim 2008).

ICT AND ICT-RELATED INDUSTRIES

MSC Malaysia (formerly known as the Multimedia Super Corridor) was set up in 1996 with the aim of building a competitive cluster of local ICT companies and a sustainable ICT industry. It is a national initiative to promote both the national ICT industry (to transform them into world-class companies) and to provide a test bed for the global ICT industry. As such, the MSC provides state-of-the-art ICT and multimedia facilities in 'Cybercities' to various businesses, including major global ICT companies. As of May 2005, 67 international companies had been awarded MSC status, including Nokia, Siemens, Motorola, Alcatel, Oracle, Ericsson, IBM, Lotus, and Reuters. In 2007, 1,792 companies were awarded MSC status. Of these 1,711 are local companies, 61 are institutions of higher learning, and 20 are incubator companies (Multimedia Development Corporation 2007a).

The increasing demand for offshore shared services and outsourcing (SSO) activities worldwide has bolstered the position of MSC Malaysia as a marketing and promotional hub. The MSC's competitiveness as a global SSO destination was enhanced and by the end of 2005, more than 50 SSO companies were established, providing 12,000 high-skill jobs (Economic Planning Unit 2006).

The implementation of the MSC Malaysia is divided into three phases over a 25-year period, from 1996 to 2020. Phase 1 (1996–2003) was successfully completed with the establishment of the MSC. Phase 2, called Next Leap (2003–2010), includes the establishment of a web of corridors and the enactment of a global framework of cyber laws. In addition, at least five intelligent Malaysian cities will be linked to other global cities worldwide. In phase three (2010–2020), the benefits of MSC will be extended to the rest of the country, an International Cybercourt of Justice will be established, and 12 intelligent cities will be linked to the global information highway (Multimedia Development Corporation 2007b).

The five corridors established under phase two of MSC Malaysia are:

- Iskandar Malaysia established in 2006 in the southern region of the peninsula to promote growth in manufacturing and services.
- Northern Corridor Economic Region (NCER) launched in July 2007 with a main focus on agriculture, manufacturing, tourism and logistic services (MASSA News 2007), and covering the states of Perlis, Kedah, Pulau Pinang, and the northern part of Perak (Northern Corridor Economic Region 2007).
- East Coast Economic Region (ECER) launched in October 2007 to accelerate economic growth and elevate income levels in the east coast regions of Peninsular Malaysia, which covers the states of Kelantan, Terengganu, Pahang, and the north parts of Mersing district of Johor.
- Sabah Development Corridor launched in January 2008 with a main focus on the development of the tourism, agriculture and manufacturing sectors (*The Borneo Post Online* 2008).
- Sarawak Corridor of Renewable Energy (SCORE) launched in February 2008 primarily to develop the central region of the state encompassing Bintulu, Kapit, Sibu, Mukah dan Sarikei divisions, which will focus on energy-based industries (Bernama 2008). SCORE is expected to channel electricity generated in Sarawak to Sabah and Peninsular Malaysia, to ensure that the whole country receives abundant and reasonably priced electricity for generations to come (*The Star* 2008).

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Malaysia privatized its telecommunication and broadcasting industries in the late 1980s to make these sectors more globally competitive. Furthermore, Malaysia set up the National IT Council in 1994 to take charge of policy formulation, strategic direction setting, policy coordination and evaluation, technology assessment and adoption, and industry promotion (Abu Hassan and Hasim 2008).

The focus of ICT development in Malaysia includes (Economic Planning Unit 2006):

- Enhancing Malaysia's position as a global ICT and multi-media hub;
- Expanding the communications network to ensure more equitable access to information and services;
- Intensifying efforts at bridging the digital divide;
- Developing the existing cyber cities as well as promoting new cyber centres and MSC multimedia applications;
- Fostering new sources of growth in the ICT sector, including bioinformatics;
- Developing a skilled ICT workforce;
- Accelerating e-learning acculturation; and
- Enhancing information security.

The government also launched the Malaysian Public Sector Strategic Plan in August 2003 to provide a clear direction for the utilization of ICT for service delivery. The plan identifies several high impact community and other initiatives to provide access to the services of multiple agencies from a single point or window. These include a business community portal, a citizen-centric portal, a government-to-employee portal, e-social services, e-learning, online income tax services, and an integrated financial management system.

A total of MYR 12.9 billion is allocated for ICT-related programs and projects such as the computerization of government agencies, bridging the digital divide among schools, a communications infrastructure service provision program, telecentres and ICT training/services, and MSC multimedia applications.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The development of IT and multimedia without appropriate laws in place can result in abuses that in turn can discourage the

use of such technologies. In Malaysia, six cyber laws govern ICT use: the Communications and Multimedia Act 1998, the Malaysian Communication and Multimedia Commission 1998, the Computer Crimes Act 1997, the Digital Signature Act 1997, the Telemedicine Act 1997, and the Copyright (Amendment) Act 1997 (Abu Hassan and Hasim 2008).

The Malaysian Communication and Multimedia Commission (MCMC) is the regulator for the converging communications and multimedia industry. It also oversees the new regulatory framework for the converging industries of telecommunications, broadcasting, and online activities.

Information security is a major focus, with an intensive effort being taken to enhance the confidentiality, integrity, and availability of online information systems. The National Information Security Framework Study provides comprehensive guidelines on information security management, mechanisms for institutional networking and coordination, as well as strategies for intellectual capital development. Other key initiatives in this area are the establishment of the National ICT Security and Emergency Response Centre (NISER), which provides skill development and consultancy services, and the formation of the Malaysia Computer Emergency Response Team (MyCERT) to tackle security issues for the private sector.

DIGITAL CONTENT

Several digital content projects are being implemented by the government, private entities, and NGOs to help expose Malaysians, especially in rural communities, to computers and the Internet. These projects include the Infodesa program of the Ministry of Rural and Regional Development, the Rural Internet Centre (RIC) project of the MEWC, and the e-Melaka project of the Melaka state government.

Infodesa is a program to encourage rural people to engage in small scale entrepreneurship projects and programs addressing the digital divide. It involves setting up a one-stop centre equipped with ICT facilities for easy and fast access to information. There are 34 Infodesa projects throughout the country. Among the topics available at the Infodesa Web page are agro tourism, village industries, health, education, agriculture, animal husbandry, fisheries, e-services and e-government, local community, and opportunities and incentives.

There are 42 RICs nationwide, each with its own website where community members can interact. The websites contain information about the history of the community, youth, women, arts and culture, health, agriculture, security, entrepreneurship, and tourism.

The e-Melaka webpage contains information on 12 flagship projects, namely: e-government, e-education, e-business, e-youth, e-mosque, e-media, e-community, e-tourism, e-politics, e-health, e-security, and e-women (Bahagian K-Ekonomi, Jabatan Ketua Menteri Melaka 2007).

Malaysians are increasingly being influenced by digital content. It has been said that one factor in the ruling party's loss of its two-thirds majority in the parliament in the March 2008 general elections is the increased capacity of citizens to get information from digital sources (Welsh 2008). Because the opposition was denied balanced coverage in the mainstream media, it relied on alternative media such as the Internet, blogs, SMS, mailing lists, listservs, and YouTube to get its campaign messages to the public. Not surprisingly, many politicians have set up their own blog sites.

ONLINE SERVICES

The Malaysian government is actively promoting the online services available on www.gov.my, the official portal of the Malaysian government. The portal includes an e-transaction centre where individuals can obtain online services and download forms for transacting with various government agencies and local authorities. At present there are nearly 1,000 forms that can be downloaded. The portal also has quick links to the government directory, government tenders, job vacancies in government, information and policies, weather information, as well as public complaints, feedback and inquiry, and immigration and customs service feedback.

In general, Malaysians enjoy a host of online services provided by both the government and private sector. The public can access these services through the Internet, cellular phones, and ASTRO's interactive television channel. As of the third quarter of 2007, there were almost 12 million dial-up Internet subscribers, 1.3 million broadband Internet subscribers, 22 million cellular phone subscribers (MCMC 2007), and more than 2.3 million ASTRO subscribers (ASTRO 2008).

With regard to e-commerce, the public can now pay utility bills and engage in bank transactions online. Although online shopping is still not as popular as online banking, the public has started booking airline tickets online and comparing online prices before making hotel reservations.

ICT-RELATED EDUCATION

One of the government's main initiatives is the Smart Schools Project started in 2006. The project seeks to integrate ICTs in teaching and learning and in school management in order to prepare students for an information-based society. Primary and secondary schools throughout the country are provided with

hardware, applications, and training in ICT-supported teaching and learning processes and school administration.

At the higher education level there is the HEdStart Program, a joint program organized by Microsoft, public universities, and Prestariang System Sdn. Bhd. The program objective is to provide computer skills training for students and certification that is recognized worldwide.

The private sector is involved in non-formal computer training through joint venture projects such as the Maxis Cyberkids Camp and Maxis Cyberlab. The camp trains teachers and students in how to use computers and the Internet. Those who have attended the Camp would then train their friends and peers. The Maxis Cyberlab project conducts computer skills training for rural communities (MEWC n.d.).

OPEN SOURCE

The Malaysian government has been promoting open source software (OSS) since 2004. The use of OSS is envisioned to promote interoperability among ICT systems and accelerate growth in the local ICT industry. To facilitate the adoption of OSS, the government has set up the Open Source Competency Center (OSCC) under MAMPU as the single point of reference on OSS. The OSCC is tasked with guiding, facilitating, coordinating, and monitoring the implementation of OSS in the public sector. It enters into collaborative partnerships with the public and private sector to provide training and technical support, and to pursue research and development (R&D). To date the OSCC has released five products through its R&D activities: MySpamGuard, MySurfGuard, MyNetWatch, MyMeeting, and MyWorkSpace (Malaysian Public Sector 2006).

The Malaysian government target is for all public agencies to have switched to OSS by 2010. As of 2007, 25 percent of the public sector has adopted OSS. Thus, it seems that the government through MAMPU and the OSCC are likely to achieve its target.

ICT FOR DEVELOPMENT RESEARCH AND DEVELOPMENT

ICT for development (ICTD) is being advocated by many sectors. However, using ICT for community development requires a complete package of hardware, software, facilities, personnel, training, and applications. More important, the community itself must be involved in the planning, implementation, and management of ICT projects. A multi-stakeholder approach would also improve project sustainability.

In Malaysia, the first step in encouraging communities to use ICT is bridging the digital divide. Norizan et al. (2007) reported

that as many as 1,670 telecentres are helping to address digital divide issues in the country. A comprehensive overview of ICT-related projects in Malaysia is available at the MEWC website (http://www.aspirasidigital.net.my).

Several studies have been conducted to assess the impact of ICT projects on communities. A study by Abu Hassan et al. (2008) found that community members who participated in programs organized by their local ICT project centres had gained computer and Internet knowledge and skills. A study by Mohd Yusof et al. (2007) compared the impact of three rural ICT projects and found that the level of exposure, knowledge, and utilization of ICT varied among the villages studied. Despite the low computer ownership and low economic status of the respondents, they were found to be willing to pay for the computer or Internet courses offered by the centres. Looking at the status of ICT development and its potential, Aziz (2007) noted that the Malaysian government is committed to inculcating an ICT culture among citizens. He proposed that an m-PortalRakyat (a mobile portal for the citizen) be set up to take advantage of the widespread use of cellular phones in the country.

CHALLENGES AND OPPORTUNITIES

The primary stakeholders in ICTD initiatives are the government and the community. The government faces the challenge of providing ICT facilities and developing policies that would encourage the participation of the private sector and other parties in ICTD projects. The community faces the challenge of ensuring that the ICT projects in their locality benefit all community members and are sustainable over the long term.

A strategy that has been proven to work in some contexts is putting the computers and Internet facilities meant for the community in the school. The ICT facilities would thus be used optimally, by the students and teachers during school days and by the community members after school hours or during the weekends. Providing adequate ICT facilities in schools would also encourage the younger generation to gain ICT experience that they can share with their parents.

It is equally important for government to ensure that the rollout of ICT facilities includes the deployment of trained personnel to manage them, as well as training programs to ensure that the facilities are not underutilized. ICT centre managers should plan with the local community activities and programs that are relevant to the community.

To encourage private sector involvement in ICTD projects, the government needs to provide incentives, such as tax breaks and social recognition. The private sector contribution may be in terms of hardware and other facilities. Companies can be

encouraged to make a long-term commitment to specific ICT projects, or to adopt a number of ICT projects. This win–win strategy would allow the company to discharge its corporate social responsibility and the community to expect better facilities for the implementation of ICTD projects.

To develop ICT knowledge and skills among community members and get them to use the available ICT facilities, regular ICT exhibitions could be held. There could be informal sharing sessions where members of the community can demonstrate a newly acquired skill or discuss ICT issues of interest to the community. Competitions among ICT centres in the state and at the national level could encourage community members to work together in promoting their communities through ICT. The communities would also learn from one another and may be encouraged to share information by linking their community websites.

In summary, with the commitment of the government to provide an integrated ICT package and the commitment of members of the community to utilize ICT facilities in ways that would lead to community development, various challenges can be overcome and opportunities can be leveraged to make Malaysia's vision of a globally competitive knowledge society a reality.

NOTE

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Maldives

Malika **Ibrahim** and Ilyas **Ahmed**

OVERVIEW

The Republic of Maldives is an archipelago stretching over 820 kilometres north–south and 128 kilometres east–west and spanning the equator in the Indian Ocean. There are 1,190 small islands, of which only 200 islands are inhabited and 80 have been developed into tourist resorts. The islands are clustered into 26 natural atolls that, for administrative purposes, are grouped into 20 atolls. The population is scattered throughout the country. But the capital, Malé, has a population of 100,000 in an area of two square kilometres.

The Maldives is a democratic republic led by a president. The People's Majlis (Constitutional Assembly) or the parliament is composed of 50 members who are directly elected by the people. However, the president appoints another eight members. In mid-2005, the People's Majlis voted unanimously in favour of introducing political parties, paving the way for a multi-party system. The People's Special 'Majlis' of the parliament was assembled through an election for the sole purpose of amending the Constitution of the Maldives to pave the way for a modern democracy.

As part of government-wide efforts to increase openness and accountability, the decision was made to telecast nationwide the proceedings of the Majlis and the Special Majlis. The government has also put extra effort into strengthening its capacity to ensure an effective and organized transition to a more open democratic and pluralist multi-party economy.

The various political developments have given rise to a wave of online content from bloggers and others freely exchanging ideas online. Government organizations have also increased the type of content posted on government websites to include information on tenders and employment opportunities. The Maldives Police Service and other law enforcement agencies update the content of their websites on a real-time basis. Most of these websites have content in English and the local language.

The economy of the Maldives is growing at a rapid pace despite many challenges posed by the lack of natural resources and the unique geography of the country. Tourism accounts for almost 20 percent of the Gross Domestic Product (GDP). Fisheries and trade follow close behind. From being one of the world's poorest countries in 1978 the Maldives is now considered a Least Developed Country (LDC) on its way to becoming a Developing Country. GDP growth averages seven percent annually. More resorts have been opened in the farthest South Atoll of Seenu and there is a new international airport. There has been much growth in the ICT sector, especially in terms of mobile coverage. Moreover, the e-government project has extended its network connection to the atoll capitals.

TECHNOLOGY INFRASTRUCTURE

There are two major telecommunication networks. One is the network established by the incumbent operator Dhiraagu to provide fixed, mobile, broadband, leased circuits, and other telecom services. The second network was established by Wataniya Telecom Maldives, the mobile operator introduced in 2005. Both provide comprehensive services nationwide via digital microwave technology. In addition, there are two international gateways established via submarine optical fibre.

Comprehensive communications services, including telephone on demand and Asymmetric Digital Subscriber Line (ADSL) broadband Internet, are now available in Malé and the major population centres in 13 islands, reaching over 40 percent of the population. All inhabited islands have access to fixed-line telephones and cellular telephone services are available throughout the country. The teledensity as of end 2007 was 11 percent for fixed telephones and 103 percent for mobile telephones.

Besides ADSL, broadband Internet is also available via cable TV networks (CATV) in Malé and a few other islands. In the islands that do not yet have broadband access, the Internet is accessed primarily through small telecentres and through mobile phones. Both cellular phone networks have Enhanced Data Rates for GSM Evolution (EDGE) technology nationwide.

As part of the e-government project, the government has established a computer network connecting the atoll capitals and government agencies. The e-government project includes developing the applications that will run on the network. The government network uses optical fibre network within Malé and very small aperture terminal (VSAT) technology to link the atoll capitals. There are plans to widen the network to include all inhabited islands.

In an effort to be better prepared for emergencies and disasters, the government has embarked on a project to establish an independent network for emergency communications and dissemination of early warnings. The project documents for this were drawn up in 2007, and the tender for the establishment of the Emergency Communication Network and Early Warning System was issued in September 2008.

KEY ICT INSTITUTIONS

The Telecommunication Authority of Maldives (TAM, http://www.tam.gov.mv) is charged with the development and regulation of the telecommunications sector, while the National Centre for Information Technology (NCIT, http://www.ncit.gov.mv) is responsible for the development, promotion and propagation of information technology (IT). These two institutions are under the aegis of the Ministry of Transport and Communication.

Since the telecom and broadcasting sectors are not converged, information and content are regulated by the Ministry of Information and Arts. Broadcasting licences are also issued by this ministry while infrastructure licences, such as radio station licences and cable TV network licences, are issued by the TAM.

Currently, there are three licenced telecommunications operators in the Maldives, namely, Dhiraagu, Wataniya Telecom

Maldives and Focus Infocom. Dhiraagu (http://www.dhiraagu.com.mv) was the sole provider of fixed, mobile and Internet services for about 17 years, until Wataniya (http://www.wataniya.com.mv) was given the licence to operate as the second mobile operator in 1999. Consumers have benefited immensely from the strong competition between these two operators. Focus Infocom (http://www.rol.net.mv/), licenced in 2003, serves as the second Internet Service Provider (ISP). Its services include high-speed broadband Internet access over CATV Network, Wireless Fidelity (WiFi) solutions for remote islands, peer-to-peer (P2P) fibre connectivity, virtual private network (VPN) solutions, and audio/video streaming services.

ICT AND ICT-RELATED INDUSTRIES

The Maldives does not have an ICT industry. However, it is an avid importer of ICT products. There are a few vendors selling hardware and software. Contributing to the bigger presence of hardware vendors is the low duty (only 5 percent) levied on imported computer hardware and consumer electronics equipment.

In October 2006, the NCIT initiated a program to establish operational modalities and guidelines for an IT Incubator and Strategic Alliance Program, following a feasibility study on the establishment of an IT industry. A set of incentives for developing an IT industry have been formulated, and an IT Industry Implementation and Marketing Plan is being drafted.

A five-year action plan called the IT Industry Blueprint has also been drafted. The plan highlights eight initiatives based on the three flagship areas of ICT infrastructure, ICT usage, and ICT facilitation. The eight initiatives are:

- ICT Precinct (ICT infrastructure) to help provide key infrastructure necessary to enter into joint ventures with offshore firms;
- Applications Development Centre (ICT infrastructure) to provide application development expertise;
- Technology Incubator (ICT infrastructure) to provide a vibrant environment for young people to establish IT ventures and learn valuable business and technical skills;
- Project Loan Support (ICT usage) to provide ready access to development funds and financing;
- Mobile Commerce and Payments Trial (ICT usage) to provide a new baseline of activity and demonstrate the broader benefits and efficiency of electronic commerce;
- Strategic Alliance Program (ICT facilitation) to create the right environment for skill, knowledge and technology transfer and promote partnerships between local enterprises and offshore companies;

- ICT Cadets (ICT facilitation) to enable young people to explore career and entrepreneurial opportunities in the IT sector; and
- Skills Certification (ICT facilitation) to raise the ICT capability, level of professionalism and commercial orientation of the local industry.

ENABLING POLICIES AND PROGRAMS

Since 2005 there has been no significant change in the institutional setup. The prevailing telecoms and IT policies are the key drivers of ICT programs. The Maldives Telecommunications Policy 2001–2005 enjoyed a successful five-year term during which most of its provisions and action plans were implemented. The aims of the policy were to reduce prices, improve accessibility, open up selected segments of the market, and strengthen the institutional capacity of the regulator. In 2006, the Maldives Telecommunications Policy 2006–2010 was issued. It aims to expand the national telecom infrastructure to provide broadband services to all parts of the country without any discriminatory charges.

The National Centre for Information Technology has been working with the United Nations Development Programme (UNDP) on the development of a National ICT Policy since 2003. Lack of project personnel and the change in government structure in July 2005 caused the delays. Initially, the National ICT Policy was an initiative of the Ministry of Communication, Science and Technology. The draft was circulated for comment among several government agencies such as the Ministry of Planning and National Development and the Public Services Division of the President's Office. The following thrust areas were identified:

- ICT for Employment Creation
- ICT for Bridging the Digital Divide
- ICT for Human Resource Development
- ICT for Good Governance

However, as of September 2008, the final National ICT Policy has not been released.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

A draft telecommunications act was completed in 2007 and is now awaiting approval by the Citizen's Majlis. The bill will be taken up during the 1st or 2nd session of the Citizen's Majlis in 2009. In the meantime, the Maldives Telecommunications Regulation 2003 is being implemented.

There are also no cyber laws. However, the issue of cyber-crime has been taken into account in other laws being drafted. The current telecom policy cites the need for cyber laws.

DIGITAL CONTENT INITIATIVES

To address the low level of published content in the local language both in print and digital formats, the government has started awarding special prizes to authors of books and CDs for children in Dhivehi, the Maldivian language. The special prizes are awarded annually by the President at a ceremony marking Republic Day.

To provide easy access to the archive of memorandums (Dhennevun) issued to government offices, the President's Office has digitized all memos issued to date and distributed these on Compact Disc-Read Only Memory (CD-ROMs) to all offices. The National Centre for Linguistic and Historical Research (NCLHR) has also begun developing digital content in Dhivehi.

There has also been a boom in radio information and entertainment content with the liberalization of the broadcasting sector in 2007.

ONLINE SERVICES

The Government of Maldives has been trying to establish an e-government service platform for some years now. The NCIT, which is overseeing the project, is working hard to develop the application infrastructure and portals required to provide online information and services to the public. The applications to be developed include the following:

- Vehicle and vessel registration, including being able to make annual fee payments over the Internet.
- Birth and death registration and certification and a health database, to facilitate the electronic registration of births and deaths and the centralized management of the Vital Statistics Database.
- Expatriate employment, allowing expatriates to pay fees for work permits and check employer status.
- Companies and licences management, enabling businesses to register businesses and apply for import licences online.
- Government mail management to track incoming and out-going mail to and from government organizations, monitor related action and provide better information to citizens about the processing of their mail to the government.

- Scheduling of government meetings, to facilitate the booking of meeting rooms and improve communication between government organizations.
- Data collection, particularly of statistical data, including data processing and sharing between government organizations.

The Maldives Police Service website (http://www.police.gov. mv/) has gained popularity as it offers very useful information and services to the general public in Dhivehi and English, including various applications forms, online leaflets and posters on crime prevention, useful statistics and the latest news.

There are currently 50 government websites, including those of state-owned public enterprises and diplomatic agencies. Very few of these websites offer interactive services to citizens. However, almost all have various forms that can be downloaded, filled in, and mailed or faxed to the relevant organization. There are also frequently asked questions (FAQs) sections that direct users to useful telephone numbers.

In August 2007, the Bank of Maldives launched the Maldives Internet Banking (MIB) service, which allows customers to pay utility bills and do other bank transactions online.

Meanwhile, the Maldives Monetary Authority is promoting mobile phone banking. The Mobile Phone Banking Project consists of two components. The first has to do with setting up the infrastructure required for the payment system, which includes the mobile payment system, a settlement system, a clearing house and a front end processing system. The second component is institutional strengthening, which includes developing an appropriate legal and regulatory framework for the mobile payment system, capacity building for project stakeholders and partners, establishing a network of banking agents to provide easy access to the system in all inhabited islands, and creating awareness of the service through educational campaigns. The project, which started in 2008, aims to make the service available in 2009.

ICT EDUCATION AND CAPACITY-BUILDING PROGRAMS

The government's developmental objectives and policies put much emphasis on the utilization of IT and IT skills training at all levels of education. However, although the application of information technology is spreading rapidly in the Republic of Maldives, particularly in business and government where big investments are being made to promote efficiency and productivity using IT, the use of IT as a tool in teaching and learning is still relatively uncommon in the general education system except for the post-secondary education sector.

Many factors contribute to this phenomenon. Computers are relatively new in many islands and island-based schools. Very few schools use even audio-visual resources to support teaching and learning. Also, access to the Internet is expensive and beyond the reach of a vast majority of the population. This is not surprising as some 40 percent of the population still live on less than a dollar a day, despite the GDP per capita of the Maldives being among the highest in South Asia.

Maldives Internet Banking

The most significant service provided to Bank of Maldives customers by the Maldives Internet Banking facility is the BillPAY service. The bills that can be paid via the MIB website include those for electricity, water, Internet, credit cards, and many other services. The MIB also allows its registered customers to do bank transactions 24 hours a day. Customers can view their financial statements, their credit card history for the last 12 months, and the status of issued cheques online. If necessary, they can stop payments of a cheque, transfer funds between their accounts, and make loan payments.

The MIB is particularly useful for customers who are travelling. For the Bank of Maldives, the MIB is a cost-effective way of dealing with numerous customers at once. Previously the bank had problems with limited physical space and one could see its customers queuing outside the bank building during peak hours.

The Bank of Maldives offers two different service plans for individuals and businesses. The Standard Package consists of the services mentioned above, including sending and receiving messages from MIB Support, activating a new credit card and debit card, reporting lost or stolen cards, and printing a receipt of every transaction. The Premium Package, which is targeted at the bank's business customers, allows making payments to accounts held at other local banks as well as accounts held at overseas banks, arranging for standing orders, and uploading the payroll file.

(Source: Bank of Maldives 2007)

Another factor is the lack of a clear policy on the use of IT in teaching and learning. In the post-secondary education sector, the IT education initiative has come mainly from the institutions themselves. At the primary and middle school levels, IT literacy classes are optional. Consequently, attention to IT-supported teaching and learning is diluted. This problem is aggravated by a massive shortage of skilled personnel who can support the development of IT-supported learning and teaching systems.

However, a Ministy of Education project called Teacher Resource Centre and funded by the United Nations Children's Fund is underway to provide training for teachers in island-based schools. The project aims to facilitate the professional development of teachers using high-quality audio-visual equipment and Internet-based resources. Under the project one centre will be established in each atoll to support the professional development of teachers serving in the general education sector.

While this is the case in the non-post-secondary education sector, IT use and multimedia-based teaching and learning systems are prevalent in the technical and vocational education sectors. The Maldives College of Higher Education (MCHE), the only publicly funded higher education institution in the country and which accounts for some 95 percent of the post-secondary sector, is leading the effort with initiatives in online instruction and testing. Most of the classrooms in its six faculties (health sciences, law, education, management and computing, engineering technology, and hospitality and tourism studies) and two centres (Open Learning and Maritime Studies) are equipped with audio-visual and IT resources.

Some constraints to the use of multimedia and IT in the education system are the following:

- While the Maldives enjoys one of the highest mobile phone ownership rates in South and East Asia, there is no nationwide infrastructure that would give the vast majority of the population affordable access to the Internet and IT resources. However, it is worth noting that access to IT is likely to change in the near future through community-based telecentres.
- The growth of the economy and the associated rapid expansion of the various economic sectors have created a tremendous demand for IT professionals in the public and private sectors. However, the supply is insufficient to meet this demand. Additionally, compensation for IT professionals in the public sector is far below market rates. Thus, it is almost impossible to attract sufficient IT talent into the education sector. The alternative is to import skills, but this would have some economic and social costs.
- There is a shortage of IT-savvy teachers with the passion to engage in designing and developing multimedia and IT-based

teaching and learning systems. As most schools in Malé run on two shifts, academic staff simply do not have time to devote to such efforts.
- The school infrastructure was severely damaged by the December 2004 tsunami, and the government is still working to rehabilitate damaged school infrastructure particularly in the outer atolls.

RESEARCH AND DEVELOPMENT AND OPEN SOURCE INITIATIVES

There are few research activities within the ICT sector. However, to promote research and development (R&D), the NCIT is developing incubator facilities and the new telecom policy is calling for the establishment of a think-tank for wireless and mobile technology innovations.

In the absence of organized R&D activities in ICT, the development of open source software is not significant. Open source software is also not very common in the general consumer market due to the availability of low cost unlicenced proprietary software. An exception is the use of the open source Firefox browser. Firefox is increasingly popular especially among young people, and Web developers are taking care to make websites fully compliant with Firefox.

Service providers also use a number of applications and backend software based on open source systems. Both Dhiraagu and Focus Infocom use Linux/UNIX-based applications.

Some individuals are working to promote open source applications, occasionally developing small applications such as instant messaging in Dhivehi and application add-ons.

CHALLENGES

One of the biggest challenges for the Maldives is the difference in population densities across the dispersed island nation. Few islands have populations of more than 5,000; in most islands, the population does not even reach a thousand. Still, the government has a policy of making all basic services, such as health and education, available in all inhabited islands. Needless to say, these services differ greatly in their quality in comparison to what is being offered in Malé, the capital island.

According to the 7th National Development Plan of Maldives, the key challenges that constrain sustainable development in the Maldives are:

- The devastation caused by the Asian tsunami of 2004
- The vulnerability of low lying islands and the fragility of the reef ecosystem

- The smallness, remoteness and wide dispersal of island communities
- Over-reliance on tourism
- Extreme dependency on imported fuel
- Disparities in income and access to infrastructure and services
- High levels of female and youth unemployment
- Drug abuse
- A poorly developed financial market
- A weak legal framework for development
- Eroding moral values and social norms

However, on a more positive note, the Maldives has seen tremendous growth despite the many challenges confronting it. With the exception of achieving gender equality and ensuring environmental sustainability, the Maldives has been successful in moving toward meeting the Millennium Development Goals (MDGs). The country needs to eliminate gender disparity in primary and secondary education and integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources. Achieving environmental sustainability is also one of the three pillars of progress identified by the Country Assessment Report of the World Bank. Thus, national development efforts are now focused on achieving environmental sustainability.

Prior to 2000, the Maldives government completed the project to provide telephone services to all inhabited islands. But telephone access is not sufficient for the ever increasing needs of the public. Universal service or residential telephone on demand is needed in very island. Due to the lack of economies of scale, this need has not been fulfilled except in 13 islands. But mobile telephony is now available across the nation. The next hurdle is how to provide broadband services to all islands in the absence of a wide band backbone network.

The country needs to prioritize the promotion of human development and social development. In the past, the government focused its attention on developing skills in the education and health sectors. However, since ICT has been integrated in the school curriculum, interest in ICT education is growing.

As it systematically addresses the many challenges confronting the nation, the Maldives might soon graduate from its status as an LDC to Developing Country status.

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.mn

Mongolia

Lkhagvasuren **Ariunaa** and Sambuu **Uyanga**

Total population	2,656,000 (February 2008)
Literacy rate	97.8%
	(Male = 98%; female = 97.5%)
GDP per capita	USD 2,900 (2007 est.)
Computers per 100 inhabitants	2.5
Fixed-line telephones per 100 inhabitants	6 (2007)
Mobile phone subscribers per 100 inhabitants	46 (2007)
Internet users per 100 inhabitants	0.65
Domain names registered .mn	2,020
Broadband subscribers per 100 inhabitants	0.3
Internet domestic bandwidth	155 Mbps (in rural areas); 2 Gbps (in Ulaanbaatar)
Internet international bandwidth	2.5 Gbps (June 2008)

(Sources: Ministry of Education, Culture and Science 2008; National Statistical Office of Mongolia 2008)

OVERVIEW

Many Information and Communication Technology (ICT) developments have taken place in Mongolia since 2006. The fibre optic cable backbone has been extended by more than 4,000 kilometres and the overall international bandwidth has more than doubled. Various types of ICT services are now available and service providers compete not only in network coverage, but also in service delivery. The number of mobile subscribers is over 1.1 million, representing an increase of over 35 percent from the number of subscribers in 2006. Mobile content development is one of the fastest growing services and it is contributing to the expansion of the country's ICT industry. Also, with the development of the ICT infrastructure, there is greater emphasis on ICT education at the secondary, vocational and tertiary levels.

However, a number of issues need to be addressed to further boost ICT development in Mongolia. There is a need to build a favourable policy and regulatory environment, develop human resource capacity, and foster coordination and cooperation among different stakeholders.

TECHNOLOGY INFRASTRUCTURE

Mongolia's ICT infrastructure has changed extensively in the last two years. The most significant change has been the extension of the fibre optic backbone network to up to five times its length in 2005. The backbone is now 11,500 kilometres long, connecting all of the country's 21 *aimag*[1] centres and going through 150 of the 365 *soum*[2] centres.

In January 2008, the overall international bandwidth reached 1.2 Gbps, 2.7 times more than the available bandwidth in 2006.

These changes in Mongolia's telecommunications sector took place following the split of the Mongolian Telecommunications Company into a network company and a service provider company in 2007. Also, in November 2007, the telecommunications company Skynetwork was awarded a licence to provide fixed telecommunications services within and between cities using Internet Protocol (IP), opening up new broadband services for Mongolia.

The F-Zone, a new type of wireless local loop (WLL), was introduced in July 2007 in Ulaanbaatar and 40 *soums*. There are now 5,000 users of Next Generation Network (NGN) services in the country.

KEY INSTITUTIONS DEALING WITH ICT

Government institutions responsible for ICT development in Mongolia include the Information and Communications Technology Authority (ICTA), Communications Regulatory Commission (CRC), and National Information Technology Park (NITP). The National Commission on Integrated Registration System, which is chaired by the Prime Minister and which includes the state secretaries of ministries and all heads of government agencies, was established in January 2008. One of the commission's first acts was to approve the establishment of the National Data Center with funding support from Korean investors.

The Center, which was inaugurated in May 2008, puts together all data gathered by government agencies to facilitate access to relevant information as well as coordination among government agencies.

Non-government organizations (NGOs) continue to be involved in ICT development. The Mongolian Software Industry Association (MOSA) has organized a number of activities, including approval of the MOSA Charter, meetings with association members, involvement in the development of the Master Plan on software outsourcing, and organizing a study tour to Dailian, a technology park in China. The Mongolian Internet Service Providers Association (MISPA) worked together with the ICTA to increase overall bandwidth for Mongolia to 1.2 Gbps. This resulted in the reduction of the cost of Internet access from homes and offices.

ICT AND ICT-RELATED INDUSTRIES

By the end of 2007, there were 1,194,380 mobile subscribers throughout Mongolia, with mobile operators fiercely fighting over rural settlements. The target was for mobile services to reach all of the 365 *soums* by mid-June 2008, with the Universal Service Obligation Fund (USOF) awarding contracts to mobile service providers accordingly and a World Bank project providing support for this. As of October 2008, the target has still not been met.

Internet service provision has been greatly improved with the increase in overall international bandwidth to 1.2 Gbps in 2007. The Internet connection fee for end users has been reduced: Digital Subscriber Line (DSL) connection costs for 64 Kbps are now just a third of the cost in 2006 and the cost for a 128 Kbps connection is now USD 20 per month, down from USD 69 per month in 2006. Thus, DSL connections are more affordable to households, small and medium-sized organizations and companies. In fact, the number of dial-up connections has been decreasing while the number of DSL or high-speed Internet connections is increasing. ICTA statistics indicate 17,329 Internet users in Mongolia in 2007, representing an increase of 37 percent from 2006. There are 10 more Internet service providers (ISPs), bringing the total to 34 in 2008.

Software development is one of the country's fastest growing ICT-related industries. The MOSA, established in 2007, has contributed extensively to the development of the Master Plan on Outsourcing for 2008–2015, which was approved in December 2007. It is recognized that software for development companies can not only develop software government organizations and the private sector in Mongolia but also engage in software outsourcing to other countries, such as Japan and the US. Software development companies have started introducing enterprise

resource planning (ERP) solutions to enhance and support business and government operations.

In addition to software development companies, a big number of small and medium-sized enterprises are providing computer-based services ranging from encoding documents; Internet café services; development of name cards, brochures and small publications; digital photo services and scanning services, among others.

The number of companies supplying computer hardware and accessories has remained stable. But their service delivery is now more diversified, reflecting the needs of a growing number of customers. The big supplier companies have started introducing online shopping and delivery services, including online payment systems. The popular sites offer not only sale of computers, copy machines, printers, and the like, but also a range of services, from supply of hardware to networking services and providing software solutions. In addition, a few small entrepreneurs have emerged to provide computer and equipment maintenance services.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Integrated Government Data Center

Under the newly approved National Program for Integrated Registration System, the ICTA will build the Integrated Government Data Center with a total budget of USD 5.9 million of which USD 5.2 million would be provided by the Government of Korea. The center is a centralized repository for the storage, management and dissemination of data and information generated and utilized by government organizations. The establishment of the center is expected to help government keep high standards for assuring the integrity and functionality of all government organizations, provide a reliable infrastructure for government IT operations, and ensure the availability, accessibility and integrity of public services.

e-Mongolia National Program

Extensive efforts are being undertaken by the ICTA, ICT companies, organizations and individuals to achieve 16 objectives outlined in the approved e-Mongolia National Program. For example, the Ministry of Road, Transportation and Tourism developed a regional coding system in 2007 in accordance with the objective of setting up a unified coding system in Mongolia to be used in postal services. Other activities that have been successfully completed since the approval of the e-Mongolia

program in 2005 are the 'Computers for All' program, software outsourcing, 'DSL to homes', e-government, country zip code, the 'Web for each organization, email for each person' project, and infrastructure development.

e-Government Master Plan

The e-Government Master Plan was developed with the assistance of the Korean International Promotion Agency (KIPA) in 2005. However, it has not been officially approved by the Government of Mongolia and no major activities have been carried out under it. The Master Plan needs to take into account changes that have taken place since it was drafted three years ago.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The fast growing ICT market and expanded ICT use by institutions and individuals are driving policymakers to improve current ICT policy and legislation and develop a new regulatory framework. However, despite the need for such laws, the draft General IT Law, e-commerce law, law on digital signatures and e-government law have not been approved by the Parliament of Mongolia. The submission of the draft laws was further delayed by the national elections in June 2008. Thus, there is still no formal regulation of electronic services such as e-commerce and e-taxation in Mongolia.

Within the framework of the ICT Infrastructure Development Project, an information security law was developed in 2007–2008 and is pending approval by the Parliament. The law aims to determine the legal basis and principles of activities related to information security and to establish information security measures for individuals, businesses, and government and NGOs. Moreover, the draft law on public–private partnership (PPP) for e-government has been drafted and is pending review by the government.

In addition, taxation and customs laws have been amended to reduce the tax on computers and computer accessories and to provide for an exemption from value added tax (VAT) for software products and computer supplies. As a result, the use of computers and the Internet is increasing.

DIGITAL CONTENT

Web Content

The number of local language websites is growing rapidly from year to year in Mongolia. Local language information portals

play a key role in digital content development, Internet usage and the development of the Internet community as a whole. These portals provide all kinds of information, including on education, business, sustainable development, poverty reduction, food security, finance and economy, entertainment, information technology, and others. The popular information and service portals include www.gogo.mn, www.news.mn, www.tedy.mn, www.olloo.mn, www.osmo.mn, and www.legalinfo.mn.

Under the 'public organizations Web and email project' in the e-Mongolia National Program, all government organizations have developed their own websites. According to a February 2008 survey by *My Computer*, a Mongolian IT magazine, the top Mongolian government websites are:

1. www.mta.mn (Mongolia National Tax Administration)
2. www.pmis.gov.mn (official website of the government organizations of Mongolia)
3. www.legalinfo.mn (legal information system)
4. www.mongolbank.mn (Bank of Mongolia)
5. www.open-government.mn (Open Government)

A *My Computer* survey in April 2008 of over 1,500 websites showed that 850 of these websites (57 percent) are regularly updated. Sixty-three percent uses .mn, 17 percent uses .com, 14 percent uses .org, 5 percent use .net, and 1 percent uses .biz domain names. Around 53 percent of the websites belong to business/services, 21 percent are websites of private companies, 14 percent are websites of non-government organizations and civil society, and 6 percent belongs to government organizations. The number of business and private sector websites increased by 11.5 percent, the NGO and civil society websites by 2.8 percent, and government organization websites by 5.6 percent, compared to April 2007.

The number of fully functional websites with dynamic content is growing rapidly, compared to a few years ago when most websites were static with very basic introductory information. The increase shows that organizations, service providers and users are starting to use the Internet as an information and knowledge source and they are actively using it in their daily activities.

Personal websites or blogs are increasing in number. Platforms for user-generated content are being developed and popular portals such as olloo, GoGo, Banjig, and News.mn serve as an information and knowledge base where Internet users can share information, knowledge, experiences, solutions, and opportunities.

CD-ROMs

A lot of local language content on Compact Disc-Read Only Memory (CD-ROM) is being developed. Journals and magazines

such as *My Computer*, *Computer Times*, and *Game World* and some textbooks are distributed with CD-ROMs. Most of the CD-ROMs are learning materials developed by educational organizations and projects.

Teachers and students have started using educational CD-ROMs in the Mongolian language that were distributed to all primary and secondary schools in 2006 as part of the 'Innovating ICT for Rural Education of Mongolia' (IIREM) project of the Asian Development Bank (ADB). A total of 18,220 such CD-ROMs has been distributed to 550 schools in Mongolia in 2008. Based on lessons learned and experiences gained from the implementation of the IIREM project, the Fast Track Initiative (FTI) has been jointly developed by the World Bank, ADB and the Ministry of Education, Culture, and Science (MOECS) to improve access to and the quality of basic education, including further development of CD-ROM-based training and learning materials for teachers and students.

Mobile Content

Only a few years ago, the mobile telephone was a new technology and a luxury utility. Nowadays it is an essential and civilian utility. Due to the increasing competitiveness of the mobile communication sector in Mongolia, mobile content services have been growing dramatically during the last two years.

Interactive television (TV) via short message service (SMS) is currently the most popular short message-based service in Mongolia. There are now 300,000 TV SMS subscribers and their numbers are growing. There are around 80 TV and FM stations and newspapers providing this kind of SMS pull service.

WAP services are also popular, with 100,000 subscribers nationwide. Two mobile operators, Mobicom and Skytel, offer Wireless Application Protocol (WAP) services named i-WAP and SkyWAP, respectively.

Mobile broadcasting service is offered as Mobimedia service by Mobicom and U-media service by Unitel. The main service concept is broadcasting text content and a call back feature if additional service or information is required. Mobimedia service has around 210,000 subscribers and U-media has around 2,500 subscribers.

Ring back tone service is being offered by three major mobile operators — Mobicom, Skytel, and Unitel — to around 220,000 users.

ONLINE SERVICES

Due to the increasing competitiveness of the ICT sector and better and cheaper access to the Internet, online services have been increasing in the last two years.

Government organizations now use the Internet to deliver services to citizens. The National Tax Administration of Mongolia collects tax returns (corporate income tax, VAT and withholding tax returns) from 520,000 taxpayers via its own electronic filing system (http://e-tax.mta.mn). The site averages 20–30 hits per second during tax return submission period. The Education Evaluation Center at the MOECS has an online registration system (http://www.eec.mn) that issues entry documents for final graduation exams and certificate of examination in tertiary institutions to all 16,000 prospective students in Ulaanbaatar. The website averages 1,500 visitors daily during the examination period.

e-Commerce and e-banking services are widely used by the public. Mobile service providers have their own Web-based services, such as www.tedy.mn (online phone shop), mobile. gogo.mn (mobile content, SMS), and www.u-media.mn (mobile content). Trading companies use the Internet for service delivery. Commercial banks are expanding their online services from checking account balances to complex online banking services such as money transfer, bill payments, and loan transactions. The popular Internet bank services are https://e-bank.anod.mn, https://www.ebank.mn/granet/, and http://www.egolomt.mn/. Other online services, such as e-booking (www.eticket.mn), e-hosting (http://share.gogo.mn/), e-shop, (www.rose.mn, http:// eshop.nomin.net), and e-TV broadcasting (http://www.tv5.mn/, http://www.tv9.mn/), are available.

ICT EDUCATION AND CAPACITY-BUILDING PROGRAMS

ICT in Secondary Education

The growing use of ICT in the country calls for the development of computer literacy in secondary education. However, there is a lack of policy to support effective use of ICT in education and to integrate ICT in teaching and learning. It is necessary to integrate ICT in the curriculum of each subject for new teaching tools and technology to replace and/or augment traditional teaching methods (Uyanga 2006).

According to MOECS statistics, 537,576 students (273,271 of them female) were enrolled in 754 general education schools nationwide in 2007–2008. There are 3,100 computers in 613 schools, or five computers per school on average. Most of the computers are used for teaching informatics and a limited number of computers is available for use by staff and teachers.

Due to poor infrastructure development and lack of equipment and skilled personnel, computers and the Internet are not widely used for subjects other than informatics. There are

572 (377 of them are female) informatics teachers. Secondary schools in the rural areas lack professional informatics teachers: the schools are either unable to offer informatics due to lack of teachers, or any graduate who knows a little about computers can work as an informatics teacher.

At present, several institutions are offering undergraduate and postgraduate degree courses in ICT-related fields. The Mongolian State University of Education (MSUE) and the Institute of Education are responsible for informatics teacher training and development. There are two curricula: one for informatics teachers and another for non-informatics teachers.

However, most of the graduates go on to work in non-educational sectors such as government and business. The government needs to resolve in a centralized way issues related to the training and education of informatics teachers. There is a need to increase the number of enrolments in informatics, and encourage applicants from the rural areas. In addition, it is important to introduce incentives for informatics teachers to work in schools.

Informatics Curriculum

Under the Informatics Curriculum Standard for Primary and Secondary Education that was introduced in 2005, informatics is taught starting from the fifth grade. There are five content domains: information, computer, algorithms, model, and IT.

Various activities are being implemented to improve the informatics curriculum, train teachers, and develop textbooks, training manuals and materials for secondary schools. As part of the shift to a 12-year education system, the Mongolian Informatics Curriculum Standard for Primary and Secondary Education will be updated in 2009.

ICT in Vocational Training

The compulsory ICT training in general vocational schools covers the same ground as the informatics course in secondary schools. A new vocational training centre has started providing ICT training. A franchise centre of Aptech World Wide India set up in January 2007 has over 170 students, and its newly opened media centre has attracted over 50 new students. There are also new training centres for software engineers set up with support from Japanese private investors.

The ICTA and the National Information Technology Park (NITP), in cooperation with the Japan Information Technology Engineers Examination Center (JITEC), has initiated an IT engineers skill standards and state examination system to evaluate the skills and competencies of Mongolian IT professionals. In April 2008, the Fundamental IT Engineers Examination, one of the categories of the Asian IT Engineers Professional Examination system, was officially conducted in Mongolia. Seven out of 53 engineers passed the examination and received certificates as IT engineers.

ICT in Tertiary Education

According to statistics from the MOECS, 150,326 students (91,720 of them female) were registered at 162 (49 owned by government) tertiary institutions nationwide in 2007–2008. The law on higher education requires tertiary education institutions to provide ICT education and to equip students with high professional and research capacity for science, technology, social sciences, and humanities.

ICT training at the tertiary education level can be divided into compulsory and specialized ICT training. Compulsory ICT courses are offered under various names such as 'Introduction to Computers', 'Introduction to Informatics', 'Application Programs', 'Computer Usage', and 'Computer Applications'. Compulsory ICT training aims to develop knowledge and skills in using ICT as a tool for learning. However, there are no common standards for ICT training in tertiary education nationwide, and the focus tends to be on the basics of computers and application programs. There is a need to refine the curriculum of the compulsory ICT training program to make it more relevant to training for specific professions and fields of specialization (Uyanga 2006). Specialized ICT courses are taken after compulsory ICT courses have been completed. Some such courses are programming languages, database, systems analysis and design, formal methods, and networking. These are intended for computer science majors. Courses in linear programming, systems analysis and design are offered to students majoring in maths. In addition, various maths and statistical tools are taught in these specialized courses.

At present, the following institutions are offering undergraduate and graduate courses in ICT-related fields: the Computer Science and Management School (CSMS) and the Telecommunication and Information Technology School (TITS) of the Mongolian University of Science and Technology (MUST), the School of Computer and Information Technology of the Mongolian State University of Education (MSUE), and the School of Mathematics and Computer Science (SMCS) and School of Information Technology (SIT) of the National University of Mongolia (NUM). There are also private tertiary educational institutions offering IT courses. According to statistics from the MOECS, there were 4,946 students majoring in ICT (1,813 of them female) in 2007–2008.

A consortium of Mongolian tertiary institutions training ICT specialists is currently reviewing existing training programs in

light of new developments in the ICT and education fields. Also, during the workshop on ICT for education under the 'Mega Mongolia' project, participants emphasized the need to develop a comprehensive policy on ICT in education, including the need to develop standards, build the capacity of teachers and lecturers, and update teaching methodologies.

OPEN SOURCE/OPEN CONTENT INITIATIVES

Many IT companies and some government organizations are making use of open source software. For example, the Ministry of Finance uses Sendmail as the internal mail server, along with some proprietary applications.

A new Mongolian open source content management system called MAUS is being developed based on the Joomla open source content management system.

However, use of open source software among non-IT personnel is quite low. Generally speaking, ordinary users of computer systems are not aware of the existence of open source operating systems such as FreeBSD. This is due to the lack of awareness-raising activities, such as seminars and workshops, on open source software.

ICTD RESEARCH AND DEVELOPMENT

International and donor organizations, including the ADB, International Development Research Centre (IDRC) of Canada, United States Agency for International Development (USAID), and World Bank, are helping to mobilize local research capacity especially in ICT for development (ICTD). IDRC is supporting the planning of a holistic ICTD research and development (R&D) program that includes policy studies and seminars in six areas — ICTD, e-government, health, education, business, and agriculture. About 350 people from various sectors are part of this R&D program.

CHALLENGES AND OPPORTUNITIES

Several challenges and opportunities still remain for ICTD in Mongolia. One of these is the need to strengthen the country's ICT policy and regulatory framework. Draft laws on ICT, including the draft law on e-government, e-commerce and digital signatures, should be reviewed and subsequently approved by the government.

Second, the telecommunications infrastructure needs to be expanded to reach the remote areas of the country and to reduce the digital divide between rural and urban communities and between privileged and marginalized groups of society. ICT-based services need to be developed further to reach those who are currently unable to receive those services.

Third, human resource capacity building needs to be addressed in a systematic way. There is a need for a master plan for ICT human resource development that would outline programs, curricula, information resources, delivery modes, and teacher training, among others.

Fourth, content development and delivery of e-services should be further enhanced and developed. Some aspects requiring attention are delivery of public services through ICT, integrating online payment systems with services delivery, and building telecentres for rural areas.

NOTES

1. An *aimag* is the largest administrative unit in Mongolia.
2. A *soum* is the second largest administrative unit in Mongolia.

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Myanmar

Thein **Oo** and Myint Myint **Than**

OVERVIEW

One of the more significant information and communication technology (ICT)-related developments in Myanmar is the completion of the first phase of the Yatanarpon cyber city. Officially opened on 14 December 2007, the city includes a telecommunications hub and seven incubation centres. The telecommunication hub is connected by fibre to the national fibre backbone linking all of the big cities. International fibre links to China, India, and Thailand are also to be established. Together with the South East Asia–Middle East–Western Europe–3 (SEA–ME–WE–3) submarine cable and Thai Com satellite links, these three new links will provide a reliable international connection, thereby removing a major constraint to the development of Myanmar's ICT industry.

The establishment of the USD 52 million cyber city is widely considered to be an indication of the government's commitment to ICT development and a clear invitation to the international ICT community to invest in Myanmar. A law establishing special industrial zones is being prepared and it is expected to offer investors various incentives, such as tax breaks and financial facilities.

Another significant development is the establishment of the government fibre network linking all ministries and head offices of government agencies, and a data centre housing servers for all ministries. The government broadband network provides a good opportunity for the development of e-government. There are already some e-Government efforts, such as the Government Personnel Management System (GPMS) and Electronic Document Management System (EDMS). There are also efforts by various government agencies to computerize operations.

A less positive development is the exodus of Myanmar's ICT professionals to other countries, especially Singapore. But this potential crisis also poses an advantage: the lure of high-paying jobs abroad is good motivation for Myanmar's young people to study hard and participate in local on-the-job training in private computer training institutes and ICT companies. This in turn could impact positively on the quality of local ICT training programs and ICT personnel. Already, some foreign ICT companies are establishing off-shore development centres in Myanmar. With improvements in the telecommunication infrastructure and the increasing number of skilled local human resources, significant outsourcing to Myanmar can be expected.

On the legal and regulatory front, an Electronic Transactions Law is being implemented and a root Certification Authority (CA) is being established. These will improve confidence in electronic transactions and change the way government and business are done.

All of these are indicators that ICT development is a priority in Myanmar.

TECHNOLOGY INFRASTRUCTURE

Compared to other member countries of the Association of Southeast Asian Nations (ASEAN), Myanmar has a relatively weak access network. Teledensity, including mobile telephony, is only 1.32 percent, the lowest in the ASEAN. The number of Internet users is also negligible. But the demand for telephone services is high and the minutes of use and average revenue per user (ARPU) are increasing, which implies that there are network externalities and the return on investments in telephone services will improve in the future.

The number of automated switching systems has been increasing in urban areas, while manual switches continue to be

used in rural areas. The transmission systems consist mainly of microwave links and satellite links except in Yangon and the Yangon–Mandalay route where the optical fibre cables are buried. The microwave links consist of analogue and digital links. The current transmission systems are more than enough to meet the country's telecommunications demand. Myanmar's international link is also satisfactory in the sense that the main submarine cable is backed up by a satellite link.

The current telecommunications infrastructure in Myanmar consists of the following:

Local satellite ground station	
– VSAT (station)	13
– MPT Satellite Terminal (station)	1,050
Local satellite channel	
– VSAT (station)	62
– MPT Satellite Terminal (station)	4,200
Overseas satellite ground station	3
Overseas satellite channel	543
Overseas submarine cable terminal	3
Overseas submarine cable channel	1,248
Fibre cable link (station)	240
Overseas telephone channel	2,031

As of February 2007, there were about 91,450 Internet users using dial-up (71.25 percent of users), Asymmetric Digital Subscriber Line — ADSL — (12.64 percent), broadband wireless (6.73 percent), satellite terminal (5.66 percent), fibre optic cable line (2.9 percent), X.25 line (0.65 percent) and E1 line (0.17 percent). There are 163 public access centres (PACs) in Yangon, 13 PACs in Mandalay, and 43 PACs in regional areas.

The short-term goal of Myanmar's ICT Infrastructure Master Plan is to install 100,000 lines and achieve 3.2 percent teledensity by 2010, deploy mobile base stations and switching systems in major cities to achieve a 3.5 percent mobile subscription rate, and install village phones in rural areas. The long-term vision is to achieve 30 percent teledensity with each household having access to telephone lines, reach a 25 percent mobile subscription rate, and make telephones and the Internet available at a government office in every village by 2025.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The Myanmar Posts and Telecommunications Enterprise provides all telecommunications services, including fixed and mobile access, local, national and international calls, and leased lines.

Other key institutions dealing with ICT development are the Myanmar Computer Science Development Council (MCSDC), the e-National Task Force (e-NTF), the Myanmar Computer Federation (MCF) and three associations, namely, the Myanmar Computer Professionals Association (MCPA), the Myanmar Computer Industry Association (MCIA), and the Myanmar Computer Enthusiasts Association (MCEA).

The Ministry of Science and Technology (MOST) upgraded the 24 Government Computer Colleges (GCCs) to Universities of Computer Studies on 19 January 2007. There are now 26 computer universities dedicated to professional education in ICT fields.

ICT AND ICT-RELATED INDUSTRIES

It is estimated that there are about 400,000 PCs in Myanmar, with about 20,000 personal computers (PCs) distributed monthly. The hardware industry does only trading and assembling and no manufacturing. Software development and training are the most popular business activities, with more than 50 percent of ICT businesses engaged in these activities. Hardware sales and system integration are the second and third most popular ICT businesses, respectively. This suggests that software-related businesses rather than hardware-related businesses are the key drivers of ICT development in Myanmar, although the hardware sector can be a key driver in the long-term. Since the Yatanarpon cyber city includes an area allocated for hardware manufacturing, it is expected that some foreign manufacturing companies especially from China will set up shop in the cyber city.

Most of the software used in the country is developed locally. A few software houses are doing outsourcing and joint product development with foreign partners. There are more than 50 local and two foreign software companies based at the first Myanmar ICT Park. Established in January 2002, the Park provides a very good environment for software companies.

Issues in ICT industry development in Myanmar include infrastructure, government support, technology transfer, international exposure, quality assurance, legal frameworks, standardization, and business practices.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

An ICT Master Plan for Myanmar covering the period 2006–2010 has been drafted with funding support from the Republic of Korea under the Initiative for ASEAN Integration. But the Master Plan has not been officially adopted or approved. The lack of an ICT Master Plan or a coherent set of ICT policies is the biggest weakness in Myanmar's ICT development efforts.

Adopting a Master Plan will provide direction not only to government agencies, but also to ICT business enterprises and investors.

The draft ICT Master Plan specifies strategic directions in eight areas: *(i)* infrastructure development, *(ii)* ICT industry development, *(iii)* ICT human resource development, *(iv)* e-government, *(v)* informatization and e-commerce, *(vi)* e-education and awareness building, *(vii)* ICT liberalization, and *(viii)* ICT legal framework.

The strategic directions for ICT infrastructure include: separating the regulatory and administrative management of telecommunications; taking appropriate action to attract foreign investment; minimizing the cost of telephone installation through cooperative efforts with the road/railroad construction department and the electric power department; investing in the most profitable market segments such as urban mobile subscribers, village phones, and business customers; and building the ICT infrastructure as soon as possible.

In ICT industry development, the thrust is to develop the software industry in the short term and to build a policy implementation and evaluation authority that would also support ICT human resource development and research and development (R&D). Another thrust is providing a favourable environment for ICT business in order to establish the ICT cluster and inducing low-level ICT outsourcing service from abroad in the mid-term. Developing a pool of highly skilled ICT human resources and opening up the market in line with ASEAN targets are also among the strategic directions to be pursued in this component.

The ICT Human Resource Development Master Plan is in accordance with 'The Thirty-Year Long-Term ICT Promotion Plan for Universities of Computer Studies and Government Computer Colleges' of the MOST and 'The Thirty-Year Long-Term Education Development Plan' of the Ministry of Education. The Master Plan focuses on providing appropriate incentives to facilitate ICT knowledge and technology transfer through various channels. It calls for the adoption of policy initiatives that would help the training and education sector meet the specific requirements of industry. The cooperation of all stakeholders is required to support the expansion and improvement of the quality of ICT education and training, and to promote the software industry.

The e-government component of the ICT Master Plan aims to build up fundamental infrastructure, including networks, basic applications and databases, based on lessons learned from pilot projects since 2001. It also seeks to document success stories in leadership, management, and priority projects to encourage citizens and leaders to continue to support e-government projects. A third aim is 'triggering snowball effects' or encouraging more investments in the expansion of e-government from the country's

leaders and from the citizens through the publication of success stories.

The informatization and e-commerce component aims to reflect the needs of citizens and businesses and, given the limited resources available, identify and concentrate on enhancing important industries that have a high probability of success. Best practices shall be documented and replicated in other industries in order to justify the investment in informatization and e-commerce projects. It is considered important to learn from the experiences of other countries, especially those similar to Myanmar. Targets for each stage shall be set, and informatization and e-commerce projects shall aim to promote the local ICT industry.

The e-education and awareness building component of the Master Plan consists of: *(i)* benchmarking against success factors in other nations; *(ii)* making full use of existing resources (including traditional media); *(iii)* encouraging the participation of opinion leaders; *(iv)* setting priorities and targeting the young talents first; and *(v)* cooperating with private, civil, and international entities.

In ICT liberalization, one of the prerequisites for a competitive market is the privatization of telecommunications services. The first step toward this is the separation of the service entity from the policy entity. This may be achieved by establishing a 100 percent government-owned public corporation, which may be called the Myanmar Telecommunication Authority. In the long run, shares in the company may be sold to the private sector and eventually to foreign investors. Thus, the Myanmar government will have control as structural preparations for privatization are being made. While it may be too early to liberalize and introduce competition in basic services, such as fixed and mobile voice telephony and Internet services, the government should consider relaxing regulation of the value added services (VAS) sectors. In this connection, the law should be amended such that only postal and basic telecommunications services are provided solely by the government instead of all telecommunication services.

The strategic directions for an ICT legal framework may be summarized as follows: *(i)* overhaul the ICT legal framework; *(ii)* reduce uncertainties in implementing telecommunications policy; and *(iii)* modernize the ICT legal framework.

The ICT Master Plan covers only the period 2006–2010. The preparation of the next plan is urgent if ICT development efforts are to be compatible with the national socio-economic plan.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Current ICT laws consist of the Myanmar Telegraph Act (1885), the Myanmar Wireless Telegraphy Act (1934), the Computer

Science Development Law (1996), the Electronic Transactions Law (2004), and the Wide Area Network Order (Notification No. 3/2002) concerning the establishment of a computer Web using a wide area network.

Although it includes regulations related to ICT industry promotion, the Computer Science Development Law focuses on the utilization of computer science technology. The e-Transactions Law is only a small part of a comprehensive informatization promotion law that Myanmar needs to put in place. The Wide Area Network Order focuses mainly on prohibiting illegal acts relating to networks, and not on facilitating the building and upgrading of telecommunications networks. In addition, it deals with licence regulations that should be covered by a Telecommunications Law.

Myanmar needs to adopt a Telecommunications Law. A draft has been completed and it is now being circulated among government and private organizations by the e-National Task Force. The Telecommunications Law is supposed to regulate all kinds of computer- and ICT-related activities, including: *(i)* permission to establish a telecommunications business; *(ii)* issuing licences for ownership of accessories and network service businesses; *(iii)* import and export of telecommunications materials; *(iv)* a licence to establish computer networks; *(v)* administration of the frequency spectrum; *(vi)* technological norms and standards; *(vii)* protecting users; *(viii)* prohibiting anti-competition; and *(ix)* installing and maintaining networks and accessories.

The Myanmar ICT Master Plan addresses liberalization, but only in terms of investment, production, and distribution of ICT products and services, and not in terms of telecommunications networks and services.

Until now, Myanmar's legal framework for ICT has been developed not via a systematic blueprint, but in response to temporary needs. Thus, there is a lack of harmony in some cases and regulations need to be amended in light of technological developments and changes in the ICT market.

DIGITAL CONTENT INITIATIVES

Currently, three types of fonts are in use in Myanmar: ASCII-based fonts (more than 50 fonts with various codes); partial Unicode fonts, and Unicode (Open Type) fonts. The standardization of the Myanmar character code set was approved in 1998 (between Uni1000 and Uni109F) according to ISO 10646 in Unicode Standard 3.x. But encoding standards were not defined in that version. In Unicode Standard 4.x, the Unicode Consortium has defined Myanmar Unicode encoding standards and canonical order. Some Myanmar script extension and minority languages were approved by the Unicode Consortium and published in

Unicode Standard 5.1. However, the implementation of the script has been delayed due to its complexity and the lack of uniscribe support in Microsoft operating systems.

Localization is important for bridging the digital divide. The Myanmar Unicode and Natural Language Processing (NLP) Research Centre, a non-profit and non-government organization, is spearheading localization efforts in Myanmar. Despite the lack of uniscribe support in Microsoft operating systems, the centre has successfully developed the Myanmar1 Unicode font according to Unicode Standards 4.1 and Myanmar3 Unicode font according to Unicode Standards 5.1. These can be downloaded from http://www.myanmarnlp.net.mm/. For open source platforms, the Pango module can be downloaded from http://fontforge.sourceforge.net/.

Open source alternatives are at an early stage of development and the preference for now is to have Microsoft come up with an Enabling Language Kit (ELK) for Myanmar in the near future.

ONLINE SERVICES

e-Government

In 2004 Myanmar ranked 123rd among 191 countries in the United Nations e-Government Readiness Index. Among the subindexes, Myanmar ranked 100th out of the 191 in the Web index and 182nd out of 191 in the telecommunications index.

A study by the MCF, which included a department-level survey and in-depth interviews with local experts, has found that very few staff of government agencies are allowed to use PCs and local and wide area networks. There are 1.3 computers per 100 people and the percentage of PCs connected to the Internet and email servers is about 0.06 and 0.03, respectively. This means that the PCs, the Internet, and email are hardly used and are not integrated in the government business process. According to the survey, while 46 percent of agencies have more than one information system, only 11 percent of agencies provide online public services.

Lack of skilled personnel, poor communications infrastructure, and insufficient budget were identified as the obstacles to operating information systems. Other obstacles mentioned include electricity problems, resistance of users, and lack of awareness among government leaders.

The government officials surveyed identified the following as the most important issues to be addressed by e-government: improving efficiency, reducing time spent, and information sharing. They consider public information as one of the most important factors for improving interaction between the government and citizens. Cutting bureaucratic red tape and reducing

time spent waiting for public services were also considered to be important.

In May 2005, the Myanmar government received a loan of KRW 11 billion (about USD 12.5 million) from the Korean Economic Development Cooperation Fund for the establishment of a Myanmar Basic e-Government System. The project sought to connect ministry buildings to a high-speed network and computerize basic government administration processes. The project has been completed and the fibre optic connection, network equipment and servers, data centres, and basic e-government applications are now in place. Two basic applications, the GPMS and EDMS, have been developed. However, the systems have not yet been implemented.

The delay in implementation suggests that getting the commitment of national leaders and improving telecommunication infrastructure are necessary but insufficient. Myanmar needs to put in place other fundamentals, such as setting reasonable e-government goals, developing a citizen-focused and business-centred e-government plan, prioritizing projects according to well specified criteria, reengineering business processes, and managing change.

e-Commerce

The e-ASEAN Readiness Assessment conducted by IBM at the end of 2001 puts Myanmar, Vietnam, Cambodia, and Laos at the 'emerging' stage of development of an information economy. Myanmar was ranked lowest in e-commerce. This situation has not changed much.

According to the MCF survey, less than 1 percent of the businesses surveyed have introduced informatization. Those interviewed said that informatization should first be pursued in agriculture, which accounts for more than 60 percent of the Gross Domestic Product (GDP), and finance, the foundation of industrial development. As for the level of business process informatization using an application system, about 40 percent of survey respondents said they handle less than 10 percent of business processes using an information system, and only 12 percent said they handle more than 50 percent of business processes using an application system. Most of the latter were companies in the ICT and financial industries.

More than 40 percent of the respondents were not interested in informatization. However, those from the banking, retail, travel, and agriculture industries showed a strong interest in informatization. About 40 percent of the respondents said they do not need e-commerce.

In sum, business informatization and e-commerce in Myanmar are characterized by a lack of informatization strategies, lack of awareness about informatization and e-commerce, lack of

ICT infrastructure, and lack of skilled personnel and enabling legislation.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

ICT Human Resource Development

Developing skilled human resources particularly for the software and ICT services sectors is considered a key to Myanmar's economic growth. Twenty-six universities of computer studies are helping to substantially increase the country's supply of ICT professionals. The Ministry of Education and New Century Human Resource Development NHRD Department also have their own programs for developing ICT graduates. The Ministry has a Bachelor of Computer Science program at Dagon University and Yadanabon University, and a Postgraduate Diploma and a Master of Computer Science program at Yangon University. The New Century Human Resource Development (NHRD) Department has various graduate, diploma, and certificate programs related to ICT and its graduates have been increasing steadily.

The private sector also plays an important role in ICT human resource development. Currently there are more than 100 computer schools, including 80 in Yangon, providing basic computers skills training to about 50,000 students annually.

The National Computing Centre (NCC, www.nccedu.com) alone accounts for an annual supply of 500–600 International Diplomas in Computer Studies, 400 International Advanced Diplomas, and 120 Bachelors in Computers and Information.

A recent survey conducted by the MCF found that 62 percent of the people in Yangon see the ICT industry as a promising field. This acute public awareness of the importance of ICT is identified as a major strength of ICT human resource development in Myanmar.

It is estimated that there are currently about 1,000 senior and 8,000 junior software engineers and that 25,000 software engineers will be available by 2025. The main issue in ICT human resource development is the mismatch between supply and demand, not lack of supply. The mismatch is a consequence of poor quality ICT education. There are many graduates but few who are qualified to work in the international market.

On the other hand, local companies are unable to pay skilled ICT professionals competitive salaries, and many qualified ICT engineers are migrating to Singapore, Thailand, Japan, and Australia. Although it is an issue, the brain drain may also have positive effects. First, it can increase the motivation of

individuals to seek better skills and it could encourage local ICT companies to pay higher salaries. Second, it could lead to knowledge flows and collaboration with foreign companies and research institutions. In addition, it poses opportunities for exporting technologies.

Myanmar needs to study international best practices in ICT human resource development to build a high-quality ICT workforce.

e-Education

The ultimate goal of e-education and awareness is to achieve an inclusive e-Myanmar society in which everyone — those living in urban and rural areas, the young and the old, rich, and poor — has access to information services. This is the key to a full-fledged information society where e-government and e-commerce are part of everyday life for all citizens. The three main pillars for achieving an inclusive e-Myanmar society are promoting awareness of ICT, improving digital literacy and ensuring universal access. While the vision of an e-Myanmar society is not one that can be realized quickly, two targets that may be achieved in the short term (i.e. by 2010) are: an Internet usage rate of 20 percent and a telephone penetration rate of 40 percent. By achieving these two targets by 2010, Myanmar will develop confidence in implementing the ICT Master Plan and be in a good position to initiate the next stage of development.

The Myanmar government aims to ensure that every child leaving school should be familiar with computers and be scientifically literate. To this end, the government is collaborating with the private sector and local communities to establish multimedia classrooms and small computer laboratories in high schools. Furthermore, college students are now required to complete 30 hours of IT literacy courses.

IT learning centres, electronic resource centres and computer training centres are also being set up in colleges and universities. The Ministry of Education is developing an educational Intranet system linking all universities and colleges. Moreover, the Ministry of Education, in cooperation with the Ministry of Information, has launched a data broadcasting system for distance education, with more than 150 learning centres established in various colleges, universities and institutes, and multimedia high schools.

CONCLUSION

Myanmar's commitment to ICT development is apparent in the establishment of the Yatanarpon cyber city, improvements to the national backbone and international connectivity, the government fibre network and e-government projects, computer universities in regional areas, public access centres in the rural areas, and efforts at localization.

These efforts are characterized by an emphasis on hard infrastructure over soft infrastructure, quantity of ICT graduates over quality of ICT training, and computerization of government procedures rather than business process reengineering. Such a one-sided approach is not sufficient to produce a good outcome. In fact, ICT development in Myanmar to date has had little impact on socio-economic development.

Nevertheless, these efforts are necessary and we can expect ICT development in Myanmar to improve as lessons are learned and good and proven practices from other countries are emulated.

Given its strategic location between two of the world's biggest countries, China and India, its abundant natural resources, and its cheap labour force, Myanmar has the potential to become a high growth country. But it is still at an early stage of ICT development. The supply side of ICT development, such as the telecommunication infrastructure, computer penetration and access points, will be improved if the present level of effort is maintained. Improving the legal framework and developing relevant applications will require more time and effort from both the public and private sectors. Devising a mechanism for effective collaboration and cooperation will be a key success factor.

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Nepal

Sushil **Pandey** and Basanta **Shrestha**

Total population	27,094,000[a]
GDP per capita	(PPP) USD 1,550[a]
Key economic sectors	Agriculture, tourism, remittance
Computer per 100 inhabitants	NA
Fixed-line telephones per 100 inhabitants	2.99[b]
Mobile phone subscribers per 100 inhabitants	9.46[b]
Internet users per 100 inhabitants	0.31[b]
Domain names registered under .np	13,200 as of April 2008[c]
Broadband subscribers per 100 inhabitants	NA
Internet domestic bandwidth	NA
Internet international bandwidth	52 Mbps and 116 Mbps (uplink and downlink)[b]

(Sources: [a]UNDP 2008; [b]Nepal Telecommunications Authority 2008; [c]Mercantile Communications 2008)

OVERVIEW

In Nepal's current state of transition, the political agenda has taken priority over everything else, including ICT development. However, with the successful holding of the long overdue constituent assembly election in April 2008 following the signing of a historic peace accord, Nepal has entered a new era of political stability that is expected to usher in economic growth, including leapfrogging developments in ICT. The new leadership has acknowledged the importance and potential of ICT for development, although it has yet to actively promote and develop it.

A major ICT program rolled out in 2008 consists of government initiatives promoting e-governance. Progress in connectivity across the country is being made. Teledensity in Nepal as of January 2008 was 12.45, up from 1 in 1999. The recent deregulation of Internet telephony is encouraging and could lead to further expansion of connectivity, which in turn could provide unprecedented opportunities for developing education, tourism, health education, agriculture, trade, and various other sectors.

But more definitely needs to be done to make ICT services accessible to the masses. ICT can help extend educational opportunities to a wider segment of the population and meet the education targets of the Millennium Development Goals (MDGs). In particular, making available ICT-based distance learning facilities in the rural areas could improve access to educational resources and good quality teaching for students living in rural areas, and thus redress the imbalance of teachers and facilities being concentrated in the urban areas. A promising initiative is the One Laptop per Child (OLPC) Nepal project, which focuses on developing materials that are linked to the national curriculum to be used with the laptops, besides taking steps to scale up the project for nationwide coverage.

TECHNOLOGY INFRASTRUCTURE

The completion of the optical fibre network is considered essential as it will be the backbone for telecommunication services, including Internet services. With the completion of the second phase covering a distance of 900 kilometres, all of Nepal will be connected to India via several connecting points and the country will have a complete optical fibre backbone from east to west. The Indian government is funding the project for the most part.

Nepal Telecom (NT), with funding support from the Chinese government for the fibre optic project along the 115-kilometre Arniko Highway linking Kathmandu to Khasa, which borders China on the north, is set to complete the project. Once these two landmark projects are brought into operation by early 2009, Nepal will have the capability to link with the major nodal communication gateways of the world, which would substantially enhance its global communications capability. This can lead to cheaper and reliable alternatives to existing satellite communications, and prepare the ground for many kinds of ICT services ranging from telemedicine to e-education. Nepal would also eventually be a part of the Asian information superhighway connecting many countries in the Asian region.

At present there is a project to connect, via very small aperture terminals (VSATs), 1,000 Village Development Committees (VDCs) out of Nepal's 3,915 VDCs in mountainous regions

where other modes of telecommunications are not considered to be feasible. Each of the 1,000 VDCs will have two telephone lines via solar-powered VSAT technology to be used mainly for voice transmission. Once all VDCs are connected, the next target could be setting up telecommunication services or telecentre facilities in each ward of a VDC (nine wards make up a VDC). Wireless Fidelity (WiFi) and Worldwide Interoperability for Microwave Access (WiMAX) networks promise convergence and economic access by leapfrogging older technologies and could be a good means to establish telecentres at the ward level.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

Government ministries with a direct role in ICT development include the Ministry of Environment, Science and Technology (MOEST) and the Ministry of Information and Communication (MoIC). The MOEST formulates and coordinates ICT policy, while the MOIC has oversight over the telecommunications, postal, mass media, and broadcasting sectors.

The High Level Commission on IT (HLCIT) is an apex body under the MOEST providing crucial strategic direction and helping to formulate appropriate policy responses for the development of the ICT sector. It seeks to harness new technologies to meet key developmental challenges such as governance reform and catalyzing economic growth for poverty reduction. The National Information Technology Council (NITC), as the secretariat for the HLCIT, looks after the implementation aspects.

The Nepal Telecommunications Authority (NTA) is the regulatory body for telecommunications, including Internet service providers (ISPs).

The Internet Service Provider's Association of Nepal (ISPAN) is the umbrella organization for ISPs. ISPAN is committed to advocate for and support a healthy Internet industry in the country. It works closely with telecom operators, ministries involved in ICT-related matters, and various other organizations on various issues that affect the implementation of the ISPs' projects.

Among the telecom operators, NT and United Telecom Limited (UTL) operate fixed-line services. NT is the leading and the largest telecommunications service provider in the country. After serving the nation for 29 years as a wholly-owned government corporation, it was transformed into the present Nepal Telecom in 2004 to become a public, business-oriented, customer-focused company in a competitive environment. Shares in the company were recently floated in the market. In the mobile market NT and Spice Nepal (SNPL) are the two operators.

Through the NTA, the government made a policy decision in March 2008 to invite a new operator, the fifth for the country, to provide telecom services to the western part of Nepal.

The NGO sector is active in using ICT for development. Organizations like FIT Nepal aim to bring the benefits of ICT to the rural and marginalized communities of Nepal by establishing community centres and building capacity in ICT use. e-Networking Research and Development (ENRD), another NGO, conducts basic computer education and hardware training in the rural areas. The organization Room to Read founded by John Wood, a former top executive of Microsoft, continues to establish computer labs in rural areas of Nepal. Rural Education and Development (READ), a Kathmandu-based NGO, is supporting no-cost public access to computers and the Internet and is committed to promoting computer literacy.

There are also organizations like IT Professional Forum (ITPF) and the Computer Association of Nepal (CAN) that work for the IT industry as a whole, including the educational and business aspects.

ICT AND ICT-RELATED INDUSTRIES

The Nepali IT market consists of hardware and software services, including business process outsourcing (BPO) services, call centres, software development, and creating solutions. Although the ICT industry is small and immature compared to the ICT industry in more developed countries, there are companies, such as D2Hawkeye, Mercantile, HiTech Valley, Yomari, Serving Minds, and GeoSpatial, managed by visionary leaders and successfully providing products and services consistent with international norms.

The CAN estimates the volume of software business in the country to have crossed USD 40 million. Still, the expected rapid growth of the software industry has not taken place.

Some companies doing IT-enabled services are transforming Nepal into a global outsourcing centre, but their number is still limited. Aside from call centre services, they are engaged in software development, database maintenance, website creation, medical transcription, and digitization of maps. This sector needs to be developed further with appropriate policies, as it not only brings in foreign exchange but also provides employment on a large scale. Companies that have survived and are growing despite high insurance costs, political instability, average investment ranking in global markets, and average infrastructure (electricity and Internet), deserve appreciation. They contribute to economic growth and serve as models for others to emulate.

Fixed-line penetration has reached 2.99, with NT and UTL having a market share of 87 percent and 13 percent, respectively.

NT is providing services in all of the districts of Nepal through wired and wireless technology while UTL is providing service through wireless technology.

Lately, there has been a tremendous increase in the number of mobile subscribers. SNPL now holds 40.27 percent of the market share, while the market share of the incumbent NT has increased to 59.73 percent. The mobile customer base is growing continuously due to the prepaid mobile scheme, which is approaching the two million mark. Besides the Kathmandu Valley, NT provides mobile services in 43 districts while SNPL has extended its service to 34 districts. NT is aiming for an additional 3.5 million Global System for Mobile communications (GSM) users and 2 million Code Division Multiple Access (CDMA) users in the next three years.

Teledensity in Nepal as of January 2008 was around 12.45 — i.e. 2.99 for fixed line and 9.46 for mobile phones.

There are currently 35 ISPs in the Nepalese market. Total international bandwidth used is in the ratio of 1:2.25 with 52 and 116 Mbps for uplink and downlink, respectively.

NT, which is also an ISP, has introduced ADSL into Kathmandu to start with, and plans to expand to 85,000 lines all over the country for its fixed-line customers. The NTA has also asked NT to allow private ISPs to sell the service.

The use of the partly completed optical fibre link to India has reduced the cost of leased capacity for downstream ISPs and ultimately for the users. Using this new link, NT has increased its Internet bandwidth capacity to 400 Mbps. In the coming years, demand for broadband services with applications like video on demand and IPTV is likely to emerge and ISPs might also have to think about introducing Next Generation Network (NGN) technology. Recently, the NTA also decided to allow the ISP for Internet telephony to process and carry voice signals through the Internet Protocol (IP) network after obtaining a licence for this.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Two policies govern the development of ICT in Nepal — the IT policy of 2000 and the Telecommunications Policy of 2004. Both have been extensively discussed in earlier issues of the *Digital Review of Asia Pacific*.

What needs to be pointed out now is that the IT policy needs to be revised in light of many new developments in the last few years and the highly dynamic environment. The HLCIT drafted a new IT policy in 2005 but this has remained on paper. The draft policy envisions Nepal as a knowledge-based society by 2015 through the effective use of ICTs to help achieve the goals of good governance, poverty reduction, and social and economic development.

The government also aims to achieve a teledensity of 24 by 2010, which is the end of the current three-year interim plan. Ten periodic plans have been completed in the five decades of planned development in Nepal. The current plan, the first after the epochal political change in the country, is seen as an interim one.

One of the key thrusts of the government is the implementation of the broad e-governance master plan developed by the HLCIT in 2006 with the help of the Korean government. The five-year Master Plan covers e-health, e-agriculture, e-education, as well as the delivery of basic public services. Its aim is economic development and productivity enhancement. A budget of USD 75 million has been allocated for its implementation beginning early 2008. The Asian Development Bank (ADB) has committed USD 30 million and the Korean government has committed another USD 30 million. The Government of Nepal will bear the rest.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The NTA is the telecommunications and Internet regulatory body of Nepal. This autonomous body was established in February 1998 in accordance with the Telecommunications Act 1997 and the Telecommunications Regulation 1998. Its objective is to create a favourable and competitive environment for the development, expansion, and operation of telecommunications services with the participation of the private sector.

In December 2006, Nepal promulgated the Electronic Transaction Act, also known as the Cyber Law, which legalizes all electronic transactions and digital signatures. The law also defines and sets penalties for computer and cybercrimes, such as hacking, piracy, and computer fraud. The Kathmandu Metropolitan Police Crime Division (KMPCD) has set up a separate Cyber Cell to deal with criminal cases involving cyber technology. The Supreme Court has started treating email correspondence as legal for judicial purposes. Earlier, only correspondence via facsimile and postal mail was considered authentic for judicial purposes.

In August 2007, the Parliament enacted the Right to Information Act (RTI), which requires all public offices — constitutional bodies, ministries, and NGOs, among others — to appoint information officers who will disseminate information about their respective offices in the interest of transparency and accountability. The Act affirms the principle that if information is denied to the public, the exercise of free expression is severely limited.

DIGITAL CONTENT INITIATIVES

The tourism industry has a strong Web presence. Tourism is a key sector of the Nepalese economy, and all major hotels, guesthouses, travel agencies, trekking agencies, and airlines have websites introducing their services. Many provide online services such as booking and planning. These tourism-oriented websites provide appealing content featuring graphics and photographs that highlight the country's culture, adventure activities, and the beauty of the Himalayas.

Many government ministries and departments as well as municipalities now have websites as well. Details of policies, speeches, laws, regulations, circulars, manuals, forms, and other information regarding the agencies are found in these websites. Majority are published in English but Nepali content is also slowly gaining prominence. Most international NGOs and many local NGOs also provide content focusing on their work, sharing knowledge and helping improve public access to quality information.

Most major newspapers in Nepal have an online presence. Major television networks also provide Internet-based news services. Some radio stations broadcast their programs on the Web, while a few radio stations have also started podcasting music to serve on-demand users. Popular magazines and webzines are likewise increasing their presence on the Web. These online news and current affairs services are useful for the international community, particularly non-resident Nepalese.

Although Nepal has lagged behind other countries in the use of computer-based ICTs, it is one of the countries in Asia where the concept and practice of community radio have been successfully implemented. Nepal's experience in community radio is considered worldwide as an innovative and successful model particularly for countries with a difficult terrain and a dispersed and isolated population. Community radio delivers both entertainment and developmental content. Outside Kathmandu valley, community radio stations are also now using the Internet to share digital content produced from a central hub in Kathmandu.

User-generated content in social networking sites has been increasing lately. These sites, which are community-focused, feature message boards, discussions, photo galleries, and videos by Nepalese living in various parts of the world. A growing number of blog sites are portraying Nepal and Nepalese as perceived by ordinary Nepali citizens. Sajha.com and weblognepal.com are two examples. Photo blogs are also emerging.

Entertainment websites in Nepalese feature sports, music, movies, fashion, and Nepali artists and models.

In the education sector, all of Nepal's four universities provide detailed information, including programs and courses offered, on the Web. Private schools are beginning to acquire a Web presence. There are also online directories and almanacs that can be used to locate schools, colleges, and training institutions in Nepal. In addition, the results of university and board examinations are published on the Web on a regular basis. However, there are hardly any courseware and educational materials linked to the curriculum.

ONLINE SERVICES

Although an act on electronic transaction is now in place, e-commerce in Nepal is just starting. Some banks have tied up with a host of third party vendors for e-shopping and e-payment services to allow online purchases and payments from all leading online shopping portals in the country.

The Nepal Stock Exchange (NEPSE) has granted brokers permission to start online trading of shares through the Wide Area Network (WAN), thus paving the way for online transactions in the Nepali stock market. The new facility allows selected stock brokers to place orders, sell, or buy shares from their office via the Internet without going to the capital market.

Many emerging private commercial banks now offer Internet banking services. A full range of services is provided to clients, from basic services such as viewing and printing account statements and requesting cheque books, to advanced functions such as transferring funds to different accounts, opening letters of credit, and bank guarantees. A few banks have also launched a short message service (SMS) alert facility whereby customers receive an SMS when transactions are made on their accounts. While they may be old hat in developed countries, these services are a significant development in Nepal.

In e-government, an ambitious master plan is being implemented with assistance from the donor community. In line with the e-Government Master Plan, the ADB released in January 2008 a USD 25 million grant to bring the Internet and other IT products and services to remote areas of Nepal through the establishment of telecentres.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

The MDG Needs Assessment for Nepal shows that the government must invest USD 12.6 billion over the next decade if the MDGs are to be reached. More than half of this amount must be channelled to efforts to reduce poverty, improve education, and develop critical infrastructure. ICTs in education can broaden access, enhance the quality of teaching and learning, and make education provision more cost-effective.

However, while most of the private schools, which are located in major city centres and district headquarters, have included computer studies in the curriculum even as early as Grade 3, most other schools claim to have never seen a computer. Schools in the rural areas, many of which are government-run, compare poorly to schools in the cities in terms of computer facilities or access to educational materials and resources. On the other hand, computer education is now part of the secondary education curriculum and computer science has been introduced at the upper secondary education level as an elective subject.

In two remote government schools in the Lalitpur district, Open Learning Exchange-Nepal (OLE-Nepal), in coordination with the Department of Education, has formally launched the OLPC project. The laptops are intended for students in Grades 2 and 6 for initial use in English and Mathematics. Out of the 200 laptops donated by the Danish IT Society, OLE-Nepal has distributed 132 laptops. It is planning to introduce this project to other districts, including Makwanpur and Mustang. The Department of Education is thinking of integrating the OLPC project into the national system. But training teachers to effectively utilize this technology is equally important.

ICT in education projects are more relevant to teachers and students when there are curricular components, as in the OLPC project, which is linked with the Grade 6 Mathematics and English syllabus. The OLPC initiative can play a vital role in making ICT-supported education sustainable in Nepal. More importantly, it has a large open source base that enables localization and modification, which develops a sense of ownership. The challenge is more than to give laptops to children; it is how to develop educational materials that can enhance the teaching and learning process. ICT-enhanced educational materials are most useful when they are directly linked to the curriculum.

In higher education, formal programs in ICT are offered in all of Nepal's four universities, namely, Tribhuwan University, Kathmandu University, Pokhara University, and Purbanchal University. In addition, there are 56 ICT colleges operating in the country. According to CAN statistics, some 4,000 ICT graduates are produced every year. A large number of them go abroad where there are better work opportunities.

While some colleges and universities have offered one or two distance learning courses for students in campus, Kathmandu University has created its own courseware server using Moodle, a learning management platform. Additionally, distance learning courses are available in selected institutions that are affiliated with universities abroad. While a true distance education system has yet to be seen in Nepal, the potential for developing e-learning as a means to expand educational opportunities

is high. Providing e-learning in the rural areas would increase equitable access to quality education for all. Already the government is working on establishing its first open university along the lines of similar universities in the South Asia region.

The Nepal Research and Education Network (NREN) led by Prime College was established recently to support advanced research through a high-speed data transfer network linking colleges, universities, and research centres.

Private training institutes are offering internationally recognized training courses, including those for Microsoft Certified Professional (MCP), Microsoft Certified System Engineer (MCSE), and Cisco Certified Network Associate (CCNA). Computer learning centres and training institutes, which have mushroomed all over the country, offer short courses on a wide variety of computer software use and applications. Some 28 percent of the total ICT workforce work as trainers and instructors in these training institutes.

Under the e-governance program, the government is also designing human resources development programs for government employees. Still, most ministries and government agencies are badly equipped to meet technical capacity. There is no career path for ICT professionals in the civil service, which makes it difficult to attract computer specialists to work for the government.

OPEN SOURCE/OPEN CONTENT

The development of NepaLinux by Madan Puraskar Pustakalaya (MPP, http://www.mpp.org.np), through the PAN Localization Project, is a significant contribution to the promotion of free and open source software (FOSS) and computing in Nepali. With every release of NepalLinux, the MPP team has been trying to make the system more user-friendly. MPP is also conducting Training of Trainers seminars to develop technical people who can deploy NepaLinux in the different rural user communities. In addition, there are plans to introduce NepaLinux and the localized software to some 25 schools initially.

The FOSS Nepal Community, which can be reached at fossnepal-committee@googlegroups.com, is becoming increasingly active in informing the general public about the usefulness and benefits of FOSS. Notably, the FOSS Nepal Community was declared one of the three winners of the Software Freedom Day (SFD) 2007 Best Event Global Competition, an annual event celebrated worldwide on the third Saturday of September.

However, there is no national policy regarding open source software or content. This is one of the issues that the government should address through a new IT policy.

ICT AND ICTD RESEARCH AND DEVELOPMENT

The PAN Localization Project has been extended up to January 2010. The Madan Puraskar Pustakalaya (MPP) aims to use the extension period to develop the Nepali Optical Character Recognition (OCR) system and further refine NepaLinux and other utilities such as the Nepali spell checker, thesaurus, and Nepali Unicode support.

An innovative application of wireless computer technology to connect Nangi, a remote native village in Nepal, to the global village won for Mahabir Pun, a 52-year-old Nepali citizen, the 2007 Ramon Magsaysay Award for community leadership. With several organizations working on ICT for rural development, Pun worked to establish wireless networks in his village supported with applications like telemedicine and education.[1] Pun is now working on connecting more rural areas with WiFi, including Makawanpur district, Dolakha, and some 15 districts in far western Nepal. His efforts are said to have influenced the government to de-licence the WiFi band, which led to the legalization of IP telephony.

Meanwhile, a decade since it was started, the government has finally completed the construction of Nepal's first IT Park at Banepa, 26 kilometres east of Kathmandu. The IT Park, which is to be operated by the HLCIT, cost NPR 260 million (about USD 400,000). NT laid the optical fibre cable from Kathmandu to Banepa for the communications infrastructure. The project included a plan to develop Banepa into an information technology city.

However, despite the investments in the necessary physical facilities, an ultra modern communications system, earthquake-resistant buildings, and various concessional schemes, the IT Park has not been able to attract a good number of IT companies and entrepreneurs and it has remained almost idle. A serious effort to assess the current obstacles to growth and formulate a favourable policy to attract entrepreneurs and companies to the IT Park is needed. Some thought must be given to how the IT Park can attract international companies, given the presence of similar IT parks in other countries in the region.

CONCLUSION

The e-governance master plan initiated in 2008 is a large-scale program covering e-health, e-agriculture, e-education, and other areas. It is hoped that the plan will not remain on paper but rather aid in value creation, productivity enhancement, economic development, and citizen-focused delivery of public services.

Putting in place a new IT policy should also be a priority, as it would serve as the blueprint for bringing in much needed foreign investment and developing the ICT industry. With the new political setup in Nepal, there is a greater need now for a new IT policy that would enable leapfrogging developments in ICT and ICT applications for development.

The technical breakthroughs in localization need to be exploited to make computing accessible to the majority of the population. In addition, rural connectivity and ICT use in the rural areas should be expanded through use of such technologies as WiFi, WiMAX, and Voice over Internet Protocol (VoIP).

With the advent of peace and political stability, expectations of Nepal's renewal are high. Much depends on the work of the constituent assembly over the next two and half years. There are definitely challenges but opportunities too prevail. Policymakers and the new leadership would do well to consider building a new Nepal based on the concept of e-Nepal.

NOTE

1. Pun's project was featured in the 2005–2006 edition of the *Digital Review of Asia Pacific*, before he received the Magsaysay Award.

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New Zealand

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ABOUT AOTEAROA NEW ZEALAND

Aotearoa, known as New Zealand in the English-speaking world, is an island nation at the south-western edge of Te Moana-Nui-A-Kiwa (South Pacific Ocean) and 1,600 kilometres from Australia's eastern coast. Comparable in size (268,680 square kilometres) to the United Kingdom and the Philippines, it is one of the world's least crowded countries (SNZ 2008b).

The first Polynesian settlement dates to 1,000 years ago and British settlement on a large scale occurred only in the last 170 years. In 1840, the British Crown and the indigenous Maori signed *Te Tiriti O Waitangi* (the Treaty of Waitangi). New Zealand was the first country in the world to give women the vote in 1893, and in 1947 it became independent from Great Britain. The Waitangi Tribunal was formed in 1975 to investigate Treaty breaches, and in 1987, contrary to the wishes of some of the world's largest and most powerful nations, New Zealand was the first country to declare itself nuclear-free.

New Zealand has a population of 4.26 million. Europeans are the largest ethnic group (68 percent), and the indigenous Maori, are the second largest (15 percent). Asians comprise 8.3 percent and Pacific peoples 6.2 percent (SNZ 2006). Maori, English, and sign languages are official languages, with English as the main language.

New Zealand's Gross Domestic Product (GDP) per capita is lower than the Organisation for Economic Co-operation and Development (OECD) average, although it ranks high on OECD quality of life indicators (MED 2007). It is a small, open economy and has a parliamentary democracy based on the Westminster Cabinet system.

Most exports, mainly to Australia, Japan, and the United States (US), are based on a highly efficient primary sector (SNZ 2008b;

MED 2007). The largest import is oil. Manufactured products, such as mechanical and electrical machinery, vehicles, and textiles, comprise almost three quarters of all imports (SNZ 2008b).

TECHNOLOGY INFRASTRUCTURE

Telecom New Zealand (telecom.co.nz) owns most of the infrastructure. Its monopoly accounts for poor performance and a poor competitive environment. However, recent government interventions are changing the situation and competition and new services are emerging.

The only backhaul service to the country is the Southern Cross Cable Network (www.southerncrosscables.com), a submarine network providing international bandwidth between Australia, New Zealand, Hawaii, and the US. The cable is owned by Telecom New Zealand (50 percent), SingTel Optus (40 percent), and Verizon Business (10 percent). Upgrades will increase the capacity from 240 Gbps to 860 Gbps by the end of 2008. A second submarine cable network is planned for 2010 between government-owned Kordia and Pipe International, and will provide competition and a diversity of routes in the event of catastrophic failure of existing networks.

New Zealand's Internet service provider (ISP) market is dominated by Telecom's Xtra and TelstraClear (www.telstraclear.co.nz). The two companies control 75 percent of the broadband and 78 percent of the dial-up markets (Paul Budde Communication Pty Ltd 2007). In 2007, there were 57 ISPs with 1,505,100 subscribers (SNZ 2007a).

There is little investment in fibre-to-the-home or premises, a reliance on ageing copper cables, and performance issues with backhaul networks (HiGrowth and NZCID 2007). Terrestrial broadband access is available to 95 percent of homes, but subscriptions — 16.5 for every 100 households — are well below the OECD average, with New Zealand ranking 20th out of 24 countries (MED 2007). The number of broadband subscribers overtook the number of dial-up subscribers in 2007 (MED 2007a).

The actual speeds for Digital Subscriber Line (DSL) download are 7.6 Mbit per second at best, with a maximum upload speed of 2 Mbit per second (Keall 2007). DSL is the most common connection technology for broadband, but as fibre speeds outshine other technologies, including DSL, cable, and wireless, by a factor of 60, the high proportion of DSL services is a disadvantage (MED 2007a).

Most broadband plans have data caps that restrict the amount of content that can be sent before additional charges apply. Exceeding the data allowance results in either a drop to a speed of 64 Kbit per second or a charge per MiB/GiB over a limit. This is unique to New Zealand.

In 2008, TelstraClear (owned by Australia's telecommunications company Telstra) has been investing heavily in infrastructure, laying fibre networks in several cities, and building a fibre backbone through the country. At the entry level, TelstraClear offers 1 Gb of data and 2 Mbit per second both up and down — five times more data, eight times faster download speed, and 16 times faster upload speed for a similar price at Telecom's entry level.

The country's main cellular service providers are Telecom and Vodafone (www.vodafone.co.nz). There are 4.25 million subscribers, just 0.01 million short of the total population of New Zealand, so the market is approaching saturation. In 2007, Vodafone had a 53.7 percent share of the market, and Telecom had about 49 percent market share. New player NZ Communications (previously Econet) hopes to offer another mobile service in 2009. Overall, New Zealand's cellular service prices ranked in the third quartile of the OECD (MED 2007a).

The government launched free-to-air digital television in 2007 for a combination satellite and digital terrestrial transmission system called Freeview (freeviewnz.tv). The service, the third largest television platform and second largest digital platform, overcomes the poor reception caused by New Zealand's rugged topography. After a year of operation, over 100,000 Freeview satellite television (TV) receivers have been sold and Freeview has launched its terrestrial service Freeview|HD, which broadcasts in high definition. Analogue transmission signals will be switched off by 2012, or when digital television is available in 75 percent of New Zealand households, whichever happens first (MCH n.d.).

KEY ORGANIZATIONS DEALING WITH ICT

The Ministry of Economic Development (MED) drives the government's Digital Strategy (NZ Government 2005), which is a shared strategy for the government, business, and community sectors. The MED is also responsible for the efficient use of the radio spectrum in the provision of telecommunications and broadcasting services (Broadcasting Standards Authority 2006).

The Commerce Commission enforces regulation and legislation that promote competition in the telecommunications industry. It determines whether mergers and acquisitions should proceed based on whether the proposal will have the effect of substantially lessening competition in a market (Broadcasting Standards Authority 2006).

The Ministry for Culture and Heritage (MCH) oversees broadcasting content regulation and administers government funding to broadcasting related organizations. It reserves radio and television broadcasting frequencies for non-commercial purposes (Broadcasting Standards Authority 2006).

Te Puni Kokiri (Ministry of Maori Development) (TPK, www.tpk.govt.nz) develops policy on reserving radio and television broadcasting frequencies for the promotion of Maori language and culture, for determining successful applicants, and for monitoring compliance (Broadcasting Standards Authority 2006).

The Telecommunications Users Association of New Zealand (TUANZ, www.tuanz.org.nz) is a non-profit organization promoting the needs of end users. Its 500 corporate members represent banks, credit card companies, supermarkets, universities, government agencies, telecommunications carriers, and others. The TUANZ is represented on the Telecommunications Carriers' Forum (TCF, www.tcf.org.nz), the recognized industry body in the Telecommunications Act 2001.

The TCF aims to promote competition for the benefit of end users of telecommunications services. It prepares telecommunications access codes for approval by the Commerce Commission and facilitates dialogue on industry issues.

InternetNZ (www.internetnz.net.nz) is a non-profit organization of ISPs, Web designers, academics, public information groups, and Internet users. It represents New Zealand for the .nz country code.

The Internet Service Providers Association of New Zealand (ISPANZ, www.ispanz.org.nz) is a non-profit industry group consisting of all of the ISPs except Telecom and TelstraClear. The organization promotes a competitive marketplace. Its primary goals include improving New Zealand's poor inter-national ranking for broadband uptake, enabling businesses to become more competitive internationally, and improving pricing and services.

ICT AND ICT-RELATED INDUSTRIES

The country's ICT companies are mostly focused on the domestic market and the level of technology products exported is far behind the OECD average (MED 2007). Sales from the ICT industry amounted to NZD 18.2 billion in 2007 with exports of ICT goods and services at NZD 1.5 billion and domestic sales at NZD 16.7 billion. Electronic devices and equipment were the leading export products with NZD 304 million in sales (SNZ 2008d).

There are 2,181 ICT businesses and they are typically small, with 96 percent employing fewer than 20 people (SNZ 2008b).

KEY ICT STRATEGIES, POLICIES, AND PROGRAMS

New Zealand needs policies and programs that are tailored to its environment, its isolation from key markets, its small size, its natural strengths and resources, and its talents (MED 2007b).

In 2006, the government adopted its Economic Transformation Agenda to carve out an approach for a more productive, innovative, and export-led economy.

The government's 2008 New Zealand Digital Strategy (www. digitalstrategy.govt.nz) lists five sectors of interest: communities, businesses, government, Maori, and the research sector. It identifies four enablers: connection, confidence, content, and collaboration. The *connection* enabler aims to place New Zealand in the top quarter of the OECD for broadband uptake by 2010. The *confidence* enabler aims to provide people with the skills and confidence to find and use information, and to ensure a secure online environment. The *content* enabler aims to provide easy access to information that is important to people's lives, businesses, and cultural identity. *Collaboration* supports efforts between communities, businesses, government, researchers, and Maori to achieve the strategy's targets earlier than planned. Initiatives linked to the Digital Strategy since 2005 are:

- The regulation of telecom, including local loop unbundling, structural separation, and making 'naked DSL' available.
- Kiwi Advanced Research and Education Network (www. karen.net.nz), a high-speed telecommunications network for research and education that provides a fibre optic cable with links to Sydney and Seattle at speeds of up to 10 Gb per second.
- Government Shared Network providing a secure fibre optic network for government agencies in the capital city Wellington, a wide area network (WAN) for government agencies anywhere on a secure voice and data capable network,

Internet access, Internet Protocol (IP) telephony, secure remote access and offsite data storage (WCC 2007).

The ICT Strategic Framework for Education (www.minedu. govt.nz) seeks to increase confidence, capability, and capacity; create greater opportunities for the generation, application, and sharing of new technologies; and increase effective and efficient investment in ICT. Interoperability and ease of access to, and between, systems and information is important (MoE 2006a).

The Public Broadcasting Programme of Action (www.mch. govt.nz) aims for the successful development of digital broadcasting services. It recognizes that digital broadcasting will further globalize popular culture and that there is a potential for New Zealand to stimulate the development of internationally marketable technical and creative skills (MCH 2005).

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The Telecommunications Act 2001 regulates the supply of services. It provides for the Commerce Commission overseeing competition, determining terms and conditions for access, and deciding how costs will be allocated among industry participants. The commission also monitors and enforces telecom's operational separation.

The legislation was changed extensively following the Telecommunications Amendment Act (No. 2) in 2006. Among the changes were the:

- Appointment of a Telecommunications Commissioner to resolve disputes over access, and to recommend regulation of new services or changes to the existing regulation.
- 2006 local loop unbundling that enabled competition in the last mile of copper between the exchange and the consumer.
- Allowance of naked DSL where consumers can purchase broadband without the accompanying phone service.
- Prospect of a *structural* separation of telecom if the government is dissatisfied with its operational separation.

The Broadcasting Act 1989 makes broadcasters responsible for program standards and establishes the Broadcasting Standards Authority as a referral and approval body (Broadcasting Standards Authority 2006). In 1989, broadcasting was deregulated to encourage competition and to increase consumer choice. However, the content would continue to be regulated. As sources and distribution routes for digital content multiply,

current regulatory mechanisms have become impractical. Global initiatives attempt to prevent the distribution of potentially harmful and illegal material, such as child pornography, and detrimental content such as spam, but most providers of illegal content are not located in New Zealand. Therefore, New Zealand legislators are focusing on filtering and giving consumers greater responsibility.

But the reality of self-regulation is difficult. To gain viewer attention, broadcasters test the regulation by broadcasting programs that some believe is 'shocking'. Also, when Grand Theft Auto IV went on sale in May 2008 under an R18 classification (not suitable for under 18 years of age), gaming shops were faced with parents 'demanding to buy the game with their 14 year old beside them'. Although the Office of Film and Literature Classification provides that adults buying the game for minors could face three months in prison or a NZD 10,000 fine, the parents in this case may be choosing to ignore a law that has yet to be enforced (Barton 2008).

DIGITAL CONTENT

The New Zealand Digital Content Strategy (NLNZ 2007) was one of the enablers of the 2005 Digital Strategy. It aimed for a content-rich digital New Zealand. Initiatives from the strategy included the Te Reo Maori and Pacific Languages Metadata Project to develop (or further develop) a Te Reo Maori metadata standard and a range of Pacific language standards based on the open organization Dublin Core Metadata Initiative (dublincore. org). A Dublin Core Maori translation was first made available in Te Kete Ipurangi (www.tki.org.nz) in 2004. But the only project that could be found that had applied the Dublin Core Maori metadata set was the Clearing House project (www.communityresearch.org.nz), which shares research in both English and Maori.

The Aotearoa New Zealand People's Network (www.peoplesnetworknz.org.nz), another project under the Content Strategy, uses libraries to provide free access to broadband Internet services; ICT hardware; onsite support and skill building; tools to encourage users to create, access, share and preserve content; and community repositories for citizen-created content. By April 2008 the project had rolled out to 35 regional libraries and 13 local authorities.

Escalating content creation raises environmental concerns around how data centres will store increasing collections of digital resources. There is currently no direction in the government's Digital Strategy on how the country will produce the necessary extra energy to support increasing loads on data centres. But it is clear that creating digital content at the current rates is not sustainable.

ONLINE SERVICES

Government agencies increasingly use online services to make information available to the public. They are also a target for intelligence gathering or attacks. Security in Government Departments (www.security.govt.nz) uses a security classification system for online information that is based on the Australian/ New Zealand Standard 'Information Technology — Code of Practice for Information Security Management'. The Security in the Government Sector (SIGS) addresses the protective security of both information and equipment, including physical, personnel, document, information technology, and communications. The SIGS manual is mandatory for government departments.

In 2006, the Minister for State Services launched the updated e-government strategy, *Enabling Transformation: A Strategy for e-Government 2006* (www.e.govt.nz). This all-of-government strategy seeks to enable State Services, the agency that serves the government of the day, to meet the needs of New Zealanders and reflect changes in how people want to interact with government. For example, people have become accustomed to doing their banking online, 24 hours a day, seven days a week, and they expect to deal with government in a similar way.

Other groups that are using online services include, for example, GeoNet (www.geonet.org.nz), a geological hazard monitoring system. The active Pacific Australian plates boundary passes through New Zealand, producing earthquakes, volcanoes, steep terrain, and active deformation. A major event almost anywhere in the country would affect the whole society and economy because of the country's small size and the interdependencies of infrastructure, logistics, and business. GeoNet is a network of geophysical instruments, automated software applications and staff to detect, analyze, and respond to earthquakes, volcanic activity, large landslides, and tsunami. This project won the 2007 Computerworld Excellence in the use of ICT in government.

e-Business in New Zealand currently lags behind e-business in other countries. The New Zealand government's e-commerce website (www.ecommerce.govt.nz) has not been updated since 2003, and it is difficult to find quantitative data about New Zealand e-commerce. It is likely that the country's slow broadband has impacted negatively on companies that want to develop a competitive e-commerce business. Trade Me (www.trademe.co.nz) is the only New Zealand e-commerce website that has achieved significant success. However, it was bought by Australia's Fairfax in 2006 for NZD 700 million. At the time, Trade Me accounted for over 60 percent of New Zealand's Web traffic.

e-Banking is also a growing online service sector. There are eight main banks operating in New Zealand and around 85 percent (based on assets) are Australian-owned. The Bank of New Zealand, National Bank of New Zealand, and ASB Bank offer two-factor authentication, a system where two different factors such as a piece of information or a process are used to authenticate a user. Using two factors as opposed to one delivers a higher level of authentication assurance. Phishing is a common security issue. Banks can protect customers from phishing by using the Sender Policy Framework protocol that is available to banks through their ISPs. However, no New Zealand bank has been using the protocol and the NZ Banking Association's (www.nzba.org.nz) 2007 Code of Banking Practice focuses on customer liability and responsibility.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

The IT skills shortage is illustrated by the fact that an estimated 36 out of 50 information technology (IT) occupations are difficult to fill. Around 4,000 new IT job positions are created annually, but there are only 1,300 degree or postgraduate diploma graduates each year. Only 64 percent of advertised IT positions are filled, with an average of 1.9 suitable applicants per position (WIT 2008).

Outsourcing is helping to address the shortage, but the small size of New Zealand and its companies means their negotiating power is reduced. For example, the neighbouring Australian market can negotiate shorter contracts and module outsourcing segments such as just the desktop or applications or the data centre (MOFCOM 2008).

New Zealand developers are not trained in open source technologies, and those who are proficient are often self-taught. To help address this, the Tertiary Education Commission (www.tec.govt.nz) allocates NZD 600,000 for Eduforge (eduforge.org), an open source community that shares ideas, research outcomes, open content and open source software. It supports over 180 open source projects around the globe.

New Zealand's Summer of Code (www.summerofcode.co.nz) is a non-profit program that creates job opportunities for students and workshops in top IT companies in New Zealand. The project has placed 26 students in 17 companies in Wellington and will expand into Auckland and Christchurch in 2008. It won the category of Open Source in Education in the 2007 Open Source awards (www.nzosa.org.nz).

In the area of educational content, Te Kete Ipurangi (www.tki.org.nz) is a bilingual Web portal providing educational materials for teachers and others in English and Maori. Its vision is to provide schools with an electronic platform to communicate curriculum and administrative materials, enhance teaching and learning, raise student achievement, and advance professional development for school managers and teachers.

The NetSafe Kit for Schools addresses the safety challenges of all communication technologies by providing cybersafety education for children, parents, schools, community organizations, and businesses. NetSafe's aim is to educate all New Zealanders about safe, secure, and responsible use of information and communication technology. It is delivered by the Internet Safety Group, a non-profit organization offering resources, information, and referrals to help schools maintain a cybersafe learning environment. The online service (www.netsafe.org.nz) is delivered via a website and through a free phone helpline.

OPEN SOURCE/OPEN CONTENT INITIATIVES

New Zealand's open source community is small despite organizations like the New Zealand Open Source Society (www.nzoss.org.nz) promoting open source, and the State Services Commission (www.scc.govt.nz) supporting open source use at government level. With little development of open source tools in New Zealand itself, these organizations tend to promote tools created elsewhere. Half of New Zealand's 20 largest organizations have deployed an open source operating system or applications.

The State Services Commission has paved the way for government open source deployment by publishing its position on the procurement of open source products (SSC 2003). It also issued a guide to government agencies to consider open source in their procurement processes (SSC 2006a). It follows its own advice using a Web standards compliant version of Plone and will also release the code for its new government portal (newzealand.govt.nz) under an open source GPL licence.

The Electoral Enrolment Centre (www.elections.org.nz), which maintains a record of New Zealanders who are eligible to vote, has operated on an entirely open source platform since 2003. Its platform includes Debian-based servers, Virtual Private Networks (VPNs), firewalls, mail servers and clients, databases (postgres), Web servers (Apache), public websites and intranets, call centre interfaces, management applications, and extensive network, security and application monitoring.

The 2007 Open Source Awards (www.nzosa.org.nz) raised awareness of open source initiatives by celebrating winners in education, government, business, community and the creative sectors. One of the finalist projects, Weka (www.cs.waikato.ac.

nz/~ml/weka), was created by Waikato University's Machine Learning Group. It is a potentially far reaching method of machine learning that analyses large quantities of data to make predictions or to make decisions faster and more accurately. It receives about 20–30,000 downloads per month.

The Clearing House website (www.communityresearch.org. nz) for community research has an open content approach. It allows researchers to upload content, use the Creative Commons (creativecommons.org) licences, and describe their resources using the Dublin Core and the Dublin Core Maori metadata standards. The project has developed a Code of Practice for researching with communities that encourages an open, ethical and cultural framework.

ICT AND ICTD RESEARCH AND DEVELOPMENT

New Zealand companies are typically small, with minimal (if any) research and development (R&D) activities. Most research funding comes from the Ministry of Research, Science and Technology (www.morst.govt.nz), which manages NZD 639 million a year and delegates technology-related funding to the Foundation for Research, Science, and Technology (FRST, www.frst.govt.nz). The FRST invests NZD 500 million a year in science and technology research. Its Technology for Business Growth investment aims to develop capability within firms by partially funding technically challenging R&D projects. In 2008, it invested NZD 25 million in the biological industries, biotechnology, specialized manufacturing, and information and communication technologies.

For R&D in ICT for development, the Maori economy provides an appropriate starting point. The ancestors of New Zealand's indigenous Maori people sailed to Aotearoa, several thousands of kilometres from East Polynesia, around 1,000 years ago. These purposeful journeys used converging technologies that enabled them to cross 'the mighty Pacific like a garden pond, centuries before Europeans made it across the petty Atlantic' (Belich 2001). However, following British colonization and breaches of the 1840 Treaty of Waitangi, including questionable land acquisitions, land wars and legislative maneuvers, Maori experienced a severely reduced economic base. Today, only 1.3 million hectares of the original 26.4 million hectares are designated as Maori freehold land, and Maori are represented negatively in most socio-economic factors, including employment, education, housing, and health. This makes their aspiration for development high.

Treaty settlements to tribal groupings in the 1990s and 2000s have included lump sum payments that are typically used as revenue-producing investments. The Maori economy is based on collectively owned assets, businesses of those who identify as Maori, commercial transactions involving Maori culture, and services oriented to Maori needs. It is an increasingly productive economy and was estimated in 2003 at nearly NZD 16.5 billion, 1.5 percent of the value of the New Zealand business sector (NZIER 2003). Treaty claim settlements since then have continued to add back to the asset base (TPK 2007b). However, trends show that the Maori economy is heavily based on agriculture and fisheries, sectors that are characterized by slow growth, declining profitability and heavy exposure to world markets. Approximately 60 percent of Maori assets are exposed to international trade compared to 31 percent for the whole economy (NZIER 2007). Understandably, there is a strong drive by Maori to enter digital-based businesses.

As an example, the Maori Spectrum Charitable Trust known as Te Huarahi Tika Trust (www.thtt.co.nz) and its commercial arm Hautaki Ltd were set up to provide Maori right of purchase over the third generation 3G spectrum radio frequency being auctioned by the government, and to engage a commercial partner to develop the 3G spectrum. Hautaki Limited owns 30 percent of Econet, now renamed NZ Communications, which is planning to build a third cellular network in New Zealand.

Another Maori-owned IT company, Paua Interface Ltd (www.pauainterface.com), has provided consultancy and IT services mainly, but not exclusively, to Maori and community groups since 1990. It has generated a wide range of research reports on the overlap of information technologies and Maori, ethics, intellectual property, security, governance, education, business, community, and more. Its biggest challenge is finding appropriate ICT skills among Maori, a near impossible task.

EDS New Zealand (www.eds.com), a subsidiary of the USD 20.6 billion Texas-based IT outsourcing giant, the Maori Education Trust (www.maorieducation.org.nz), and Te Puni Kokiri (TPK, www.tpk.govt.nz), the Ministry of Maori Development, are providing five scholarships for young Maori studying IT subjects. EDS is the largest IT employer in New Zealand, and it aims to increase the presence of Maori in the IT workforce while tapping in to a new resource pool in a tight labour market.

Overall, Maori have development objectives, an asset base and a desire to enter into the digital sector, and they are well positioned to meet the challenges and opportunities of the digital environment. They have shown a strong uptake of digital technology, and are prolific creators and consumers of distinct digital content particularly in the broadcasting, arts, education and academic arenas. Future reviews will have an opportunity to monitor progress.

CHALLENGES AND OPPORTUNITIES

The ICT challenge for New Zealand is mainly one of timing. The country's remoteness means high transport costs and large carbon footprints for commodity exports. Thus, digital capability is a critical issue. Many believe that the pace of ICT development in New Zealand will only maintain its low ranking in the OECD. At the current rate of fibre rollout, New Zealand will have fibre to the premises (FTTP) to only 75 percent of premises by around 2040 (WCC 2007). Innovations for the development of communities and Maori that depend on speed will not be enabled.

The situation perhaps reflects the government's contribution of just over 1 percent of the GDP to science and technology research, whereas many other countries in the OECD contribute an average of 3 percent. The economic benefits of competitive broadband access, if available, could be in the range of NZD 2.7 to NZD 4.4 billion or more per year to New Zealand's gross domestic product (NZIER 2007).

If available, high-capacity broadband would enable video conferencing, online health services, e-learning, and other applications to run simultaneously. However, the expectations of businesses to work effectively in a global online economy are not being met in New Zealand (WCC 2007). New Zealand's best innovative, export-orientated technology companies often disappear as foreign shareholders, originally brought in as strategic investors, restructure them. They move the intellectual property and the best talent overseas to where conditions and incentives are more favourable. For example, the manufacturing arm of award-winning Humanware, maker of the BrailleNote computer, was moved to Canada, closing down the Christchurch-based team and a New Zealand technology export (Griffith 2008).

In the broadcasting sector, ICT development have had major impacts with the change from analogue to digital, increased distribution options, including terrestrial and satellite transmissions, and the demand for mobile broadcasting applications and Web-based services. However, inadequate access to high-speed Internet is a constraint to the development of content for users and production companies, and it impacts negatively on the true potential of the industry (HiGrowth and NZCID 2007).

Clearly, the opportunity for New Zealand lies in its ability to address its poor infrastructure and therefore attract and keep its best talents, as well as in its ability to discover its point of differentiation in the global context. For example, it is fruitless to attempt to compete with countries that have hundreds of thousands of competent software developers and programmers when

New Zealand has only 1,300 graduates a year many of whom are from overseas and leave after graduation. But some have noted that there is a trend emerging in New Zealand's creative digital sector in film, animation, and other creative products and services that could be the key to the country's distinct contribution to the world. New Zealand has much more to offer than just jobs. It has access to a relatively clean, untouched environment with more available space per capita than any other developed country. The country is primed for creativity. Its lifestyle could well be the country's attraction to people with skills. Engaging in ICT developments that enhance New Zealand's unique environment would sustain and celebrate what the country has to offer.

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Pakistan

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Total population	150 million (est.)
Literacy rate (for those 10 years old and older)	43.92 (male = 54.81; female = 32.02) (as of 1998 census)
GDP per capita	USD 847 (PKR 5,820; USD 1 = PKR 60)
Fixed-line telephones per 100 inhabitants (including WLL)	3.5
Mobile phone subscribers per 100 inhabitants	7.5
Internet subscribers per 100 inhabitants	1.5
Broadband subscribers per 100 inhabitants	0.03
Total Internet bandwidth	800 Mbps

(Sources: Finance Division 2006; Pakistan Telecom Authority 2008; Population Census Organization 2008)

INTRODUCTION

The year 2007 was historic for Pakistan. Alternatively listed as an A+ investment country and then as the 'most dangerous place on earth', Pakistan see-sawed between optimistic economic reports, violence, political instability, and uncertainty. However, despite the odds, the country experienced a strong foreign investment influx, with over USD 9 billion invested in the telecom sector alone (Rising Pakistan 2007). Exponential growth in the telecom sector, which constitutes 2 percent of Pakistan's Gross Domestic Product (GDP) and is expected to account for 3 percent in the next three to four years, has resulted in the creation of 80,000 jobs directly and 500,000 jobs indirectly.[1]

Currently, Pakistan has about 95.7 million phones: 89 million cellular, 4.5 million fixed lines, and 2.2 million Wireless Local Loop — WLL (PTA 2008). Teledensity in 2008 stood at 59.8 percent from a mere 4 percent in 2003.

With a score of 3.7 out of 10, Pakistan ranks 63rd in 67 countries in the e-readiness ratings (Economist Intelligence Unit 2007). The information technology (IT) and IT-enabled services (ITES) sectors also boast an impressive 61.18 percent growth in exports, making Pakistan a country to watch very closely.

Information and communications technologies (ICTs) have been responsible for progress in social development areas as well, with various ICT-supported initiatives aiming to contribute to Pakistan's on track status in connection with the Millennium Development Goals (MDGs) of gender equality; maternal and child health; combating HIV/AIDs, malaria and other diseases; and ensuring environmental sustainability. However, work toward the goals for education and poverty alleviation is off track and, in the case of poverty, it is regressing. ICT planning by the

government of Pakistan (GoP) has not been able to sufficiently address this critical issue. There is failure to recognize that overall growth in telecom and ICT will be in vain if poverty and lack of education continue to destabilize the country.

TECHNOLOGY INFRASTRUCTURE

In 2003 a coherent and forward-looking telecommunications deregulation policy was formulated by the GoP with assistance from the World Bank and in consultation with all stakeholders. The policy covers Long Distance and International (LDI) and Local Loop (LL, including WLL) services. Licences were also issued for data network operators (DNOP), Internet Service Providers (ISPs), and other value added licences. A transparent process for the awarding of licences and frequencies was adopted, resulting in two new mobile phone companies as well as a number of LDI, WLL, and LL licences being issued.

Key elements like Calling Party Pays (CPP), Mobile Number Portability (MNP), dynamic interconnect, and reducing interconnection costs from the 'significant market powers' (SMPs) have spurred growth. To enable development in unserved and underserved areas through the provision of local loops and rural voice and broadband communications, a Universal Service Fund (www.usf.org.pk) from regulatory fees paid by operators and counterpart funding from the World Bank, has been established.

In 2006–2008, cellular connections in Pakistan grew from less than 12 million to over 89 million. Coupled with the increase in WLL lines, this has increased teledensity to over

59 percent. Telephone penetration is expected to go over 100 million by 2009. What is significant is the large and diverse user base that will support the launch of value added services (VAS) and new operations, as well as delivery of total solutions addressing different market segments at the same time.

The bandwidth required by cellular and other operators is also driving the broadband market. Three new nationwide optical fibre systems with an aggregated capacity of over 4.5 Terabit per second expandable to over 54 Terabit per second (on 10 GigE) have been deployed. The actual fibre penetration is much deeper and over 550 locations have fibre access on the Pakistan Telecommunications Company Ltd (PTCL) fibre. The services now on offer include dark fibre, Multi-Protocol Label Switching (MPLS), and Gigabit Ethernet.

These new systems (in addition to the older PTCL system) connect over 100 cities. Metro-rings in over 20 cities are being deployed by different operators. Niyatel has deployed Pakistan's first fibre-to-the-home (FTTH) network in Islamabad and is planning expansion to other cities. Operators are offering services ranging from triple play (voice, video, and data) to dark fibres to a whole range of end users. Access pricing has dropped to less than USD 12 per month for a 512 Kbps connection. Hybrid fibre-coaxial (HFC) cable operators are now upgrading their networks in order to offer triple play services after acquiring requisite licences from the Pakistan Telecommunication Authority (PTA) or entering into franchising relationships with existing operators.

In Internet and broadband the growth in demand has been phenomenal: over 7,700 percent over a five-year period (2003–2006), with over 12 million active users and 167,000 Internet hosts in 2007. In recent months the Direct Subscriber Line segment has been expanding due to the reduction in bandwidth prices, the PTA's implementation of a fair interconnect with the PTCL landline network, and the issuance of licences for Worldwide Interoperability for Microwave Access (WiMAX) in the 3.5 GHz band. The number of Direct Subscriber Line users stands at over 100,000. The target is 1.6 million Direct Subscriber Line users by 2009. This will be achieved through support from the Universal Service Fund and the farming out of new frequencies in the 2.3, 2.5, 3.5, and other bands for WiMAX and other new wireless technologies. As mentioned, the private sector licencees are laying metro fibre for HFC cable fibre access (fibre-to-the-curb — FTTC — and fibre-to-the-home — FTTH) in over 20 cities. The PTCL optical fibre reaches into the heartlands of over 550 locations. This will help open the rural markets as the new private sector owners expand and utilize the installed infrastructure. Based on PTA statistics, as of June 2008 the total number of broadband connections in Pakistan is 170,000 of which 65 percent is DSL

connections, 25 percent is HFC, 8 percent is WiMAX, and two percent is FTTH.

Three operators (Mobilink, Wateen, and Burraq) are deploying nationwide systems on the WiMAX 802.16 d/e standards, resulting in a huge growth of international connected bandwidth as well as rapidly dropping prices. An E1 (2 Mbps) is available at USD 1,500 per month. With competition heating up, the price is expected to drop further to sub USD 1,000 levels.

New undersea transnational fibre systems have ensured a degree of redundancy and reliability not present earlier.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

ICT development in Pakistan has gone beyond the purview of a few key entities and promotion of ICT use has been taken up by different organizations and user groups. However, on an institutionalized basis the following organizations are responsible for ICT development:

- The Ministry of Information Technology and Telecommunications (MoITT) is responsible for policy in IT and telecommunications.
- The PTA is the telecom regulatory body.
- The Universal Service Fund Guarantee Ltd (USF) is responsible for telecom development in the under-developed areas via subsidies from a contributed Fund.
- The Pakistan Software Export Board (PSEB) oversees IT growth and export.

There are several trade bodies, some of which are powerful although informal in nature. They include:

- Pakistan All Software Houses Association (PASHA)
- Internet Service Providers Association of Pakistan (ISPAK)
- Computer Society of Pakistan
- Federation of Pakistan Chambers of Commerce and Industry (FPCCI)

ICT-RELATED INDUSTRIES

With a growth rate of 61.18 percent, Pakistani ICT and ITES companies have shown remarkable growth in 2007, and local companies have been recognized at various international events. The total industry size is USD 2.8 billion. IT and ITES exports were valued at USD 1.4 billion in 2007. The export target for 2006–2007 was USD 108 million (PSEB 2008).

At the end of 2007, 1,082 IT companies were registered with PSEB. Most of these are based in Karachi (384), Lahore (353), and Islamabad (276). There are 60 foreign IT and telecoms companies in Pakistan. There are 11 IT Parks covering an area of 750,000 square feet.

Aggressive efforts by P@sha (Pakistan Software Houses Association) and the PSEB have made quality a major thrust of the industry, and international quality certifications such the Capability Maturity Model Integration (CMMI) have been actively promoted by both the private sector and government. One company is at CMM Level 5, another at CMMI Level 5, three at CMMI Level 3, and nine at CMMI Level 2. While the majority of companies are small, several have attracted sizeable foreign direct investments, and it is anticipated that within the next year or two, if Pakistan remains politically stable, the industry will see the formation of some large and more mature companies.

In 2005 there were 110,000 IT professionals employed in Pakistan's IT sector, of which more than 15,000 were engaged in export-oriented activities (e.g. software development, call centres).

Total IT spending in 2005–2006 amounted to USD 1.4 billion.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

It is interesting to see the growth of several private and public sector programs without active government intervention. For example, a segment is addressing the resource and telecentre model (e.g. Sehat First, consisting of health-based consulting and primary care telecentres) and another segment is addressing e-banking, m-commerce, and m-banking. Integral to the dynamic growth seen in the IT and telecom sectors of Pakistan is the telecom deregulation and enabling policy framework aimed at attracting foreign investments. The incentives offered include corporate tax exemptions on export earnings, 100 percent repatriation of profits, tax holidays for IT venture capital funds, and provision of a subsidized enabling infrastructure.

Pakistan's IT and telecoms policy framework has remained unchanged since its formulation in April 2000. Primary participants in the development and implementation of the policy framework include the MOITT and PSEB. Periodic informal reviews and updates have been conducted in consultation with the private sector. However, a formal new policy directive has yet to evolve.

A major policy oversight has been the lack of an ICT for development (ICTD) policy framework and non-inclusion of integrated objectives in the National IT and T Action Plan. Private sector groups, including the Federation of Pakistan Chambers of Commerce and Industry, have initiated an advocacy campaign and are currently working as catalysts to create this critical roadmap. For ICTs to have an impact on development, a consensus on policy and implementation will have to be reached by all stakeholders, including the Ministry of Commerce (MoC), Ministry of Education (MoE), Ministry of Health (MOH), Ministry of Women's Development (MOWD), and many others under the umbrella of the Pakistan Planning Commission.

In response to the call for an 'ICT for Development' plan, the government of Pakistan formulated the Universal Service Policy (USP) with the main objective of providing basic access to telecommunications to poor and underprivileged communities across Pakistan. Specifically, the USP aims to:

- Make voice telephony affordable and Internet access available to progressively greater proportions of the Pakistan population;
- Foster conducive conditions and an enabling environment in which teledensity can grow; and
- Jumpstart the broadband and ICT markets to facilitate e-services.

In terms of penetration of ICT services, the following targets have been set:

- Eighty-five percent of the population should have telecommunication coverage and therefore access to e-services if desired;
- Five percent teledensity in the rural areas;
- One percent broadband penetration; and
- Preferably one telecentre for every 5,000 people or at least one telecentre for every 10,000 people in USF contract areas. (IT and Telecom Division)

However, despite the USP, telecentres, e-services to the masses, and efforts to utilize ICTs to achieve the MDGs remain mainly on paper. Although various ministries have initiated ICT-based MDG-related projects, lack of integration with the MOITT has resulted in the failure of many of these projects, with serious consequences for citizens.

Private sector activity remains the backbone of ICTD efforts in Pakistan, and its impact is visible in government-managed projects, encompassing not only agencies responsible for IT such as the MOITT, PSEB, and EGD, but also non-traditional participants such as the Small and Medium Enterprise Development Authority (SMEDA), MOWD, and MOH. Substantial efforts by both the private sector and key government entities such as the Planning Commission will be decisive in determining whether ICT will play a role in human and social development in Pakistan.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

The Electronic Transaction Ordinance (ETO) was issued in 2002. It covers public key infrastructure (PKI) and certification authorities (CA), electronic transactions, digital signatures, and related elements that constitute the basis for secure electronic transactions over the Internet.

Recently a bill on cybercrime was promulgated amid protests from the industry against the draconian penalties and the lack of clarity with regard to building the capacity of the implementers (police, investigation agencies, lawyers, courts). The bill will undergo necessary changes after review by the new government.

New laws relating to Internet Protocol (IP) protection, data security, and consumer protection are also being drafted.

The telecoms sector has a comprehensive set of laws that are supplemented by the requisite rules and regulations. The licensing process and sector regulation have proceeded successfully and a policy review is scheduled this year.

Issues related to spectrum (e.g. WiMAX) and broadband are being tackled on a real time basis (as the issues evolve) and resolved. Considerable spectrum clearance has taken place and it is expected that more bands will be cleared for licence-free transmission,[2] in addition to the current 2.5 GHz and 5.8 GHz Wireless Fidelity (WiFi) bands.

DIGITAL CONTENT

The lack of local language content is a major challenge. The gap is being filled by individual initiative and materials are now being developed for specific applications, such as education and training, health, and social networking. Innovations like machine translation sites (www.paktranslation.com) are creating new opportunities for start-ups. Local language websites such as hamari.com and others are proliferating. Efforts are being made to transform educational content into digitally usable format for spreading education and training to the grassroots using the newly available telecom networks. In Pakistan, Urdu is the dominant language of instruction (as is English) and most of the effort is going into this space with the creation of Urdu fonts, lexicon, Unicode registration, and embedding into the Microsoft Office. There are however strong currents requiring development in regional languages (Punjabi, Sindhi, Balouchi, and Pushto), and several parallel efforts are underway to create linkages between these. Part of this initiative has been funded by the government of Pakistan (see CRULP, www.crulp.org) and some by International Development Centre's PAN R&D (research and development) Fund.

ONLINE SERVICES

e-Banking

There has been a steady increase in the number of e-banking products and services. According to the State Bank of Pakistan's quarterly report, the volume and value of e-banking transactions in the first quarter of 2007–2008 (July–September) reached 30.1 million and PKR 3.4 trillion, respectively, indicating a growth of 7.5 percent and 9.6 percent, respectively.

The total number of active cards (ATM, credit, and debit) grew by 11.9 percent to reach 6.5 million. The total number of ATM machines as of the first quarter of 2007–2008 reached 2,470, representing an increase of 7.7 percent over the previous quarter. Real Time Online Branches (RTOB) reached 4,444 and now constitute 57 percent of the total branch network in the country. The number of Point of Sale (POS) terminals available to customers was 50,004 as of the first quarter of 2007–2008, reflecting a growth of 7.9 percent over the total for the previous quarter.

Five million transactions on other e-banking channels (POS, the Internet, call centre/Interactive Voice Response or IVR, and mobile) were recorded in the same quarter, reflecting a growth of 7.7 percent over the previous quarter. These transactions had a value of PKR 27.6 billion, a 9.5 percent increase over the previous quarter.

The use of electronic channels is growing consistently as the contribution of electronic transactions has increased to 26.1 percent in number terms and 8.5 percent of the value of total retail transactions.

Internet banking includes payments and electronic funds transfer (EFT). However, EFT is currently limited to intra-bank account-to-account funds transfer except for a bank offering interbank funds transfer facility through the Internet. Internet banking in Pakistan is growing slowly but at a steady pace. In the first quarter of 2007–2008 banks reported 0.283 million transactions involving an amount of PKR 8.8 billion. The figure is projected to grow to 40 billion by the end of 2008.

e-Commerce

One of the more innovative of recent e-commerce initiatives in Pakistan is Thread Net Hunza (www.threadnethunza.com.pk), an e-commerce site spearheaded by the Karakoram Handicraft Development Programme (KHDP), a community-based enterprise system. The project promotes culture-sensitive and environmentally sustainable micro-enterprises, thereby creating village-based income and employment opportunities for artisans, small producers, women, disabled members of the community, and other disadvantaged groups. At present, around 3,000 women

artisans are working from their homes under the Thread Net Hunza project. Another 60 women work at seven workshops daily and produce finished products that are marketed under the brand name of Thread Net Hunza by local and national retailers. Tourists are the prime market, and local and national exhibitions are held to promote the products. The site has generated over PKR 3.5 million in sales.

e-Government

The government of Pakistan through its e-Government Directorate (EGD) as well as other ministries has undertaken several important projects with a potential large scale impact specifically in terms of transparency and accountability. But although some of these projects were implemented several years ago, implementation hurdles, lack of integration with appropriate agencies, poor coordination, and a lack of project scaling/replication have prevented many projects from achieving the potential levels of impact.

Independent of the EGD's initiatives, work in different autonomous government departments has been proceeding at an excellent pace. This underlines the basic fallacy of trying to drive e-government via central control instead of decentralized implementations. Some of the latter are described as follows:

CBR Automation. The GoP through the National Trade Corridor (NTC) aims to provide a single electronic window operation for trade and commerce. To achieve this objective, the Pakistan Customs Computerized System (PaCCS) was developed as a pilot project and launched on 23 March 2005. It is currently operational in all three container terminals located at Karachi Port and Port Qasim. For the second phase of the project, CBR (Central Board of Revenue, now renamed Federal Board of Revenue or FBR) plans on building on the existing system by implementing the new Pakistan Automated Commercial Community System (PACCS) throughout the country.

NADRA Database. The National Database and Registration Authority (www.nadra.gov.pk) has created the largest citizens database in Pakistan, covering data for over 80 million people. The database is being used for activities ranging from issuance of identity (ID) cards and machine readable passports to creating electoral rolls. The applications, software, and systems were developed in-house and are now being used to develop similar systems in other countries. This internal R&D of NADRA has likewise created several more products such as payment kiosks for utility bills, prepaid mobile phone cards, and vehicle tracking systems based on radio-frequency identification (RFID) technology.

Land and Revenue Records Automation. The automation of land records service delivery has been a landmark project, contributing to long-lasting tenure security and more efficient

functioning of land markets. The project has been recommended for implementation across the country. The implementation has been started in several pilot areas and since this is a provincial jurisdiction, the speed and pattern of implementation is variable across Pakistan. However, at this time each province has pilots (e.g. Lahore) and full blown public-private partnership (PPP) based programs (e.g. Karachi) are now operating. The market size for the implementation of this is over PKR 10 billion for the IT companies for nationwide data entry, creating businesses like kiosks for delivery of ownership documents and one-window operations for clearing all land-related issues across Pakistan. This also opens up opportunities for downstream applications such as land title insurance, which is opening up the land home mortgage market to stimulating businesses, for example by creating clear land titles that can be recognized by banks for collateral for mortgage/loans for farmers and other business ventures.

Strengthening Electoral Processes to Greater Participation in Pakistan (SDEPP). This project by the Electoral Commission of Pakistan (ECP) sought to improve democratic electoral processes and ensure transparent, free, fair, and impartial elections through the use of ICTs. In the recent elections a voter could check if he/she had been registered by logging on the ECP website and validating well in advance whether his/her registration was valid so interventions could be made early if there were mistakes.

Wetland Project by UNDP and WWF Pakistan. The Protection and Management of Pakistan Wetlands Project is a project funded by the United Nations Development Programme/Global Environment Facility (UNDP/GEF) being implemented by World Wildlife Fund (WWF) Pakistan. The project has produced a detailed geographic information system (GIS) with cartographic maps, satellite images, and Global Positioning System (GPS)-based field observations for better management of Pakistan's natural resources. In addition, the project has laid a strong foundation for the successful implementation of conservation and sustainable use of the biodiversity of Pakistan's wetlands. Four different wetland complexes were identified through GIS and remote sensing techniques. Additionally, field work was carried out to establish floral and faunal baseline data in collaboration with the line departments and local NGOs/community based organizations (CBOs). Threats to these resources were identified in collaboration with the key stakeholders — the communities. Other ICT-based projects resulting from this project include:

- Fauna Information System of Pakistan (FISP), a GIS containing all species of mammals and birds in Pakistan;
- Eco-zoning and land use GIS database in high altitude mountain ecosystems; and
- Land quality GIS database for saline and waterlogged lands.[3]

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

Meeting Community Education Needs through ICTs

In the late 1990s, IDRC, the Commission on Science and Technology for Sustainable Development in the South (COMSATS), the Karakoram Development Organisation, and the Baltistan Health and Education Fund started an ISP project in the remotest mountain area of Pakistan. As a result, 500 people's organizations and enterprises are now connected to the Internet and more than 100 students have been trained in computer skills. Internet connectivity has helped boost tourism, and other businesses can now communicate more easily with their clients in the south of the country and abroad. The project has also raised awareness among Pakistani women and men about the uses and benefits of ICTs, and it has demonstrated that such a facility can be made sustainable, if there is competence, long-term commitment, and effective promotion.

As of July 2005, computers and networking facilities have been installed in two schools. Students, teachers, and school administrators have started using ICTs to access low-cost, effective, and high-quality learning materials. In addition, 270 people have benefited from training in ICTs. Local youth are taking an especially keen interest in the training sessions.

In addition, e-Village resource centres have been established in two villages (as of July 2005) and e-Village resource persons have been trained to ensure that the village organizations have the necessary capacities to run these centres on their own.

The capacity building that has resulted from this project has also been recognized by the Pakistani government.

National Education Database Program (NEDP) Pakistan

The NEDP is a collaborative and innovative PPP program launched by a consortium of expert private sector enterprises and supported by Intel, Microsoft, Oracle, TeleCard, and the MOE. The project utilizes a Web-based school management software available in the local regional languages, to facilitate the collection of data at the grassroots level, thus modelling the creation of a constantly updated National Education Database.

The pilot project, which was initiated in October 2005, had the additional objective of identifying key problem areas in actual implementation, to be used in planning nationwide implementation. The project successfully implemented the locally developed EMIS system in 100 government schools. However, the project is experiencing problems due to lack of understanding of implementation issues (business processes, content,

development of software and applications, backend systems, and consistent delivery and follow-up) by the MoE.

ICT in Higher Education

Pakistan's Higher Education Commission (HEC) is implementing an agenda for reform that includes: *(i)* faculty development; *(ii)* improving access; *(iii)* excellence in learning and research; and *(iv)* relevance to national priorities. Over 500 scholars (teachers and students of graduate and postgraduate programs) are sent abroad annually to universities in Australia, Austria, France, Germany, New Zealand, Sweden, the Netherlands, the UK, and the US, and there are plans to increase the number to 1,000 scholars per year.

The HEC has also launched a mirror site of the Massachusetts Institute of Technology Open Courseware on the Pakistan Education and Research Network (PERN) (see 'The Pakistan Education and Research Network [PERN]') that enables open sharing of syllabi, lecture notes, and related materials of 914 courses.

An international lecturing program through video conferencing will also become operational in November 2008. Students in Pakistan will attend lectures interactively delivered from top universities around the world. Over 2,000 lectures by Nobel laureates and top professors have already been lined up to be beamed into Pakistan's lecture theatres.

Furthermore, the HEC has a Digital Library Programme that provides universities and R&D organizations across the country with free access to over 23,000 international journals and 45,000 textbooks from the world's leading publishing houses. The Programme has over 250 participating institutions, 30 databases, 20,000 full text journals, and 150 million items available through the British Library Document Delivery Service.

Higher education institutions that are leading the way in ICT-supported education in Pakistan are the Virtual University (VU) and the Allama Iqbal Open University (AIOU).

VU (www.vu.edu.pk) is Pakistan's first university relying completely on modern ICTs. It was established by the government as a public sector, not-for-profit institution to provide affordable world-class education to aspiring students all over the country. Using free-to-air satellite television broadcasts and the Internet, VU allows students to follow its rigorous programmes regardless of their physical location.

The AIOU (www.aiou.edu.pk), which was established in 1974, is the first open and distance learning university in Pakistan and Asia. Its main campus is in Islamabad and it has a large network of regional centres spread all over Pakistan and the Middle East. Together with the Virtual University, AIOU serves over 750,000 students (growing at 14 percent annually), three times the combined student populations of all other universities in Pakistan.

The Pakistan Education and Research Network (PERN)

PERN is a network connecting 95 universities via optical fibre and providing facilities for video conferencing, connectivity to the Internet and local networked content, and VoIP services for communication between connected universities. It was established by the HEC in 2003. Since then, ICTs have developed at a rapid pace. PERN 1, as the original network is called, is based on legacy telecommunication infrastructure that is not aligned with the modern architecture of National Research and Education Networks (NRENs) and not capable of supporting Next Generation network services and applications now being used by research and special interest groups.

Realizing the limitations of the existing network and the need to have a true end-to-end IP-based research and education network, the HEC has initiated PERN 2, which has the following core features:

- True packet switched network replacing legacy architecture
- A network architecture aligned with international practices and standards for NRENs and with connectivity to other peer networks (Internet2 and Geant2)
- Availability of high bandwidth for research and collaboration in areas like grid computing, high energy physics, telemedicine, research-related video and images exchange, and enterprise-level video conferencing

A complete transformation of the process of content creation and distribution, conversion of content for digital delivery, deployment of an independent DVB-S2 very small aperture terminal (VSAT) network for the Open University, and integration of campus management and education Enterprise Resource Planning (ERP) are some of the changes currently being implemented, for completion in 12 months (i.e. by mid-2009).

(Source: HEC 2008)

At present, approximately 20,000 IT graduates are produced each year by 110 universities in Pakistan that are offering IT and computer science programs. There are plans to set up six engineering and three technology universities in collaboration with Austria, China, France, Germany, Italy, Sweden, South Korea, and some other countries. These countries will provide the vice chancellors, faculty, training, and examination system and ensure the equivalency of degrees with their own system for 10–15 years. Each university will be established at an estimated cost of USD 400 million.

Finally, a major program has been launched by the HEC and National University of Science and Technology (NUST) to promote innovation and entrepreneurship in Pakistan that involves modification of curricula, introduction of courses in innovation and entrepreneurship within university systems, establishment of technology parks and technology incubators, and providing access to venture capital and soft loans to new start-up companies.

OPEN SOURCE/OPEN CONTENT INITIATIVES

The recently completed Open Source Industrial Automation Project was one of the most widely publicized open source projects undertaken by the PSEB. It focused on five industry sectors — textile processing, automotive parts and accessories, readymade garments, hosiery, agriculture — for the development of open source ERP products. The ERP products (along with the source code) will be available free of cost to all member units of the associations in each of these sectors.

A vibrant OSS community is involving a large user advocacy base (Free and Open Source Software — FOSSP).

ICT AND ICTD RESEARCH AND DEVELOPMENT

While ICT has penetrated into the far reaches of the country, ongoing R&D on localization tools and rural connectivity and access will be the key to whether the potential of ICT is harnessed by ordinary citizens. The release of Urdu language tools by the Centre for Research in Urdu Language Processing (CRULP) has already proven to be instrumental in the extension of e-services to the masses. The CRULP has already successfully developed the Urdu lexicon, speech recognition system and fonts, and it is now also coordinating the PAN Localization project (http://www.panl10n.net/) for seven Asian languages.

The Government of Pakistan also continues to support ICT research with the R&D Fund, which is no longer being

administered by the PTCL. The new independent fund is managed by a 17-person committee and annually receives 1 percent of the gross revenue of all telecommunication service providers. Funded projects include: Automatic Control Programming of Robots through Imitation, GIS-based Optical Fibre Network Monitoring and Management System, Low Cost Ultrasound Training Simulator, and Artificial Immune System-based General Purpose Intrusion Detection System.

CHALLENGES AND OPPORTUNITIES

The World Bank's *Doing Business 2008* report puts Pakistan in second place among South Asian countries in terms of certain economic indicators, such as ease of doing business, dealing with licences, and protecting investors. Indeed, Pakistan is quickly emerging as a powerhouse in the region, partly due to its fast paced IT industry. Government policies toward foreign investors have also contributed to making the country stand out. These policies include 100 percent foreign equity ownership, 100 percent repatriation of profits for foreign investors, and tax exemption for the sector till 2013. An increasing number of foreign companies also prefer Pakistan for their outsourcing operations due to the large pool of professionals proficient in English, cheap connectivity rates, and competitive operational costs.

Perhaps the most exciting development over the last few years is the increasing role of entrepreneurs in ICT-based projects, with younger people experimenting with launching their own businesses rather than looking for jobs. Several applications using Web 2.0, social networking, and other software-based businesses are growing. Some of these are either launched internationally (iScribe) or in advanced beta stage (paktranslations.com, thebc. com) all with venture capital and local equity funding. Other large enterprises have attracted private equity (www.lmkr.com) from big names like Actis.

In the development sector, the growth and increasing interest of the social entrepreneur is imminent as evidenced by VC (Acumen Fund) funding innovative projects like Sehat First, which is telemedicine on a sustainable and replicable basis.

All in all, the Pakistani spirit is alive and well. It has proved resilient in overcoming adversity and in converting challenges into opportunities. Growth on all sectors is positive and despite the major political and external challenges, all sectors of the Pakistani economy are going north.

The major political changes of the last few months taking Pakistan toward a broad based democracy will ensure that the pressure will be there to deliver on education, reduce poverty, and maximize the use of ICT as an enabler to optimize service delivery, reduce costs of doing business, and achieve better governance.

NOTES

1. Direct jobs are those created for setting up and operating the new networks, while indirect jobs include job in support services, outsourced operations and tasks, distribution networks, cellphone (hardware) marketing companies, and new businesses based on the spread of the telecom networks.

2. These are the industrial medical and scientific or IMS bands that do not require any licences and can be used by anyone on a 'user beware' basis since these bands are used without any protection or regulation like WiFi.

3. For more information, see http://ictd.undp.org/it4dev/gpm/ presentations/day3/Asia/pakistan/pakistan.ppt

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Philippines

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Total population	88,574,614 (as of August 2007)
	90,675,900 (2008)
Literacy rate	Female = 90.4%; male = 86.8%
GDP per capita (in USD)	USD 3,200 (2007 est.)
Computers per 100 inhabitants	7.46 (2007)
Fixed-line telephones per 100 inhabitants	4.48 (2007)
Mobile phone subscribers per	58.88 (2007)
100 inhabitants	
Internet users per 100 inhabitants	6.03 (2007)
Domain names registered under .ph	100,000
Broadband subscribers per 100 inhabitants	0.56
Internet domestic bandwidth	From 64 Kbits/s to 5 Mbits/s
	(2008)[1]
Internet international bandwidth	3,214.5 Mbps (as of 2008)

(Sources: ITU 2008; National Statistics Office 2008)

OVERVIEW

The Philippines' Information and Communication Technology (ICT) sector continued to contribute to sustainable economic and social development, despite setbacks and delays in the implementation of some projects. As early as 1972, the Philippine government recognized the significant role of ICTs in the country's growth and development when it established the National Computer Center (NCC) as the lead organization for human resources and systems development in this field. Today, the ICT sector continues to grow, with the private sector collaborating closely with government for the successful implementation of ICT programs and projects.

The Philippine ICT Roadmap of 2007 sets the country's strategic directions for achieving global competitiveness. The first strategy is to build physical infrastructure to speed up interconnectivity and assure wider public access to a minimum set of information and communications services. The second is to ensure the existence of an appropriate policy and legal environment to encourage the growth of ICT, and then allow the market to decide on how best to utilize investment, provide jobs, and stimulate progress in the sector. The third is to develop human capital that can use ICT and work in the ICT sector to enhance sustainable development.

TECHNOLOGY INFRASTRUCTURE

For wider access to ICT services, especially in unserved and underserved areas, national infrastructure development focuses on major telecommunications and ICT systems such as Cellular Mobile Telephone Service (CMTS), wired and wireless telephones, and Internet service.

In 2007, according to International Telecommunication Union (ITU) indices, there were 4.48 fixed telephone lines per 100 inhabitants and 58.88 per 100 inhabitants subscribed to mobile cellular phones. The combined fixed-line and mobile-cellular telephone density therefore rose to about 63 telephones per 100 persons in 2007.

The Philippine Long Distance Telephone Company (PLDT), the largest telecommunications company in the Philippines, and Bayan Telecommunications Inc. (BayanTel) are the major fixed line telephone service providers. In March 2000, PLDT acquired Smart Communications, which as of April 2008 had a mobile subscriber base of more than 32 million. PLDT's main competitors are Globe Telecom and Digitel in both the fixed line and mobile (via Smart's competition with Globe and Sun Cellular) markets.

BayanTel serves areas in Metro Manila, Bicol, and local exchanges service areas in the Visayas and Mindanao regions, covering nearly 33 percent of the Philippine population. A third telco, GLOBE Telecom, provides local and long distance telecommunications services to more than 12 million wireless subscribers throughout the Philippines. It also offers international wireless connectivity through partnerships with regional carriers, including Maxis Communications in Malaysia.

Internet subscribers numbered 2.5 million (or 2.84 subscribers per 100 inhabitants) in 2007. But there are far more Internet users — 5.3 million (or 6.03 users per 100 inhabitants) by some counts, and up to 14,000,000 by others. Yahoo estimates that up to 16 percent of the Philippine population is browsing and using the Internet.

Broadband subscribers numbered 496.2 in 2007, or 0.56 subscribers per 100 inhabitants. But there is strong potential for broadband growth in the Philippines because of high market awareness of the need for broadband and current low Internet penetration. In response to projected demand, PLDT, for example, has committed around PHP 20 billion (around USD 500 million) per year from 2008 to 2010 to improve its broadband connectivity. PLDT's investments in broadband connectivity are paying off with its broadband subscriber base growing by 184 percent to 302,000 by the end 2007, from 122,000 in 2006. Smart has 2,780 wireless broadband-enabled base stations providing high-speed Internet access to 625 cities and municipalities all over the Philippines. Wireless broadband revenues grew up to PHP 2.4 billion in 2007, a 190 percent improvement over the PHP 823 million in revenues in 2006.

A key development in national ICT infrastructure was the laying of the Philippine Cyber Corridor beginning 2006 as part of a strategy to gain competitiveness in the global business process outsourcing (BPO) market. This ICT channel, which runs over 600 miles from the north to the south of the Philippine archipelago, consists of a USD 10 billion high-bandwidth fibre backbone and digital network, redundant international connectivity, and reliable power supply connecting dedicated IT parks in urban areas. The channel is supported by a deregulated telecommunications environment, low rental rates with liberal terms, and proximity to internationally recognized property management companies. The IT parks are themselves major infrastructure initiatives in support of high technology industries. As of 30 June 2008, 378 IT enterprises were operating in 101 IT Parks around the country.

To provide a secure online environment for e-commerce and e-government, the Philippine government is aiming to establish a Public Key Infrastructure (PKI) Center and government Certification Authority (CA) by 2010. Work in this area started in March 2008 with a USD 3.5 million grant from the Korea International Cooperation Agency (KOICA).

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The Commission on Information and Communications Technology (CICT, http://www.cict.gov.ph) serves as the primary policymaking and coordinating entity of the Philippine executive branch for the promotion, development, and regulation of integrated and strategic ICT systems and reliable and cost-efficient communication facilities. Starting in 2007, CICT has focused on policymaking and program oversight activities, while

the responsibility for implementing programs and projects has been lodged at specific line agencies and local government units (LGUs). Attached to the CICT is the NCC, designated as CICT's e-Government Development Group.

The National Telecommunications Commission (NTC) is the regulatory body. It is attached to the Department of Transportation and Communications (DOTC).

The Department of Science and Technology (DOST), particularly through its Philippine Council for Advanced Science and Technology Research and Development (PCASTRD) and the Advanced Science and Technology Institute (ASTI), implements research and development (R&D) programs that address critical application areas and support ICT-based entrepreneurship.

The Department of Trade and Industry (DTI) through its agencies involved with investment promotion, entrepreneurship, and export development, seeks to provide an environment that would attract investors in ICT and ICT-enabled service (ITES) industries. Attached to DTI is the Board of Investments, which lists ICT and ITES in its investment priority list; the Philippine Economic Zone Authority (PEZA), which oversees the development and management of the ICT Parks; and the Philippine Export Development Council, which lists ICT and ITES as a priority export.

ICT AND ICT-RELATED INDUSTRIES

The Philippine IT industry remains bullish, primarily as a result of the continued growth of the BPO sector. The Secretary of Trade has announced that the BPO sector posted USD 3.6 billion in revenue and accounted for 244,675 jobs in 2006. With the Philippines ranking second in the International Data Corporation's (IDC) list of top 10 BPO destinations in Asia Pacific in 2007, BPO is seen as a major growth engine, with a projected revenue of USD 10 billion by 2010 at a Compound Annual Growth Rate (CAGR) of 40 percent.

In 2005 total exports from the BPO industry amounted to PHP 76.5 billion (USD 1,387.9 million), 53.6 percent higher than the PHP 49.8 billion (USD 888.2 million) reported in 2004. Exports constituted about 69.5 percent of the industry's total revenue in 2005. In the contact centre and medical and legal transcription sub-sectors, more than 95 percent of the revenue came from exports.

In 2006, animation, other BPOs, and software development had an export share to revenue of 66.4 percent, 44.2 percent, and 40.1 percent respectively. The figures suggest that these sub-sectors are also providing services to domestic firms. Specifically, the animation industry serves the domestic print and broadcast media, while the software industry caters to the

software requirements (e.g. payroll system) of large domestic corporations.

The contact centre industry is the fastest growing segment, with 112 customer contact centres nationwide. Medical and legal transcription services grew by 97 percent. Software development, animation and other BPOs also grew by double-digit rates (40.8, 35.3, and 30.5 percent respectively).

According to the XMG intelligence report, the Philippine BPO revenue is expected to grow to about USD 4.1 billion, or 1.4 percent of the global market share. The gains in the sector may be ascribed to a 32 million-strong labour force with inter-cultural adaptability, high trainability, a strong customer service orientation, and moderate to satisfactory English proficiency. Another key factor is government incentives for investors in the form of income tax holidays (ITH) of four to eight years and duty-free importation of capital equipment. Technopark or ecozone locators are awarded a special 5 percent tax rate on gross income when the period for ITH lapses. They are also exempted from the 12 percent input value added tax (VAT) on allowable local purchases of goods and services (e.g. communication charges). In addition, IT companies are allowed unrestricted use of consigned equipment, exemption from wharfage dues and exemption from tax when employing foreign nationals. Philippine outsourcing and offshoring (O&O) competencies are highlighted during trade missions, and the Philippine government has allotted PHP 350 million (USD 9 million) to training scholarships for the O&O industry.

Another major growth segment for the IT industry is computer gaming, both PC-based and online. This segment has renewed the Internet café business in the Philippines. Computer gaming, particularly online gaming, is cutting across social boundaries (gender, age, and economic class) and is driving growth in computer literacy.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

The Philippine Medium-Term Development Plan for 2004–2010 identifies ICT as one of the priority areas to help propel economic development. The plan also envisions a people-centred, inclusive, and development-oriented information society that promotes quality of life and sustainable development. Several strategies and programs are being pursued with this vision in mind.

As mentioned, the Philippine Cyber Corridor hosts BPO companies, call centres, animation studios, software development and gaming businesses, medical and legal transcription outfits, knowledge process outsourcing (KPO) outfits, and back office operations of multinational companies. Metro Manila in the north, Metro Cebu in central Philippines, and Davao City in the south are the leading locations along the Corridor. Beginning 2007, ICT businesses were put up in 17 other cities as the cyber services industry establishes regional ICT hubs that can host O&O locators and generate more jobs and bigger revenues for the host regions. Thus, whereas 92 percent of O&O jobs were in Metro Manila three years ago, this figure went down to 80 percent in 2008. The target is to achieve a 50–50 ratio between Metro Manila and regional jobs by 2010. There were 320,000 O&O jobs as of the end of 2007. The target is one million such jobs by 2010.

The Community e-Center (CeC) Roadmap for 2008–2010 was launched at the end of 2007 as part of government strategy to provide universal access to telecommunications and Internet services down to the *barangay* level. The CeCs also provide customized ICT training to community members, in partnership with the LGUs, NGOs, and other stakeholders. As of November 2008, 112 municipalities (40 percent of 295 municipalities around the country) have CeCs.

The Electronic Governance for Efficiency and Effectiveness (E3 Project) of the CICT, with PHP 400 million (USD 10 million) in support from the Canadian International Development Agency (CIDA) and a five-year timeframe (from 2007 to 2012), has three major components: *(i)* policy review; *(ii)* capacity building among key government officials; and *(iii)* pilot projects in selected social services agencies. In April 2007, the E3 Project signed a Memorandum of Understanding (MOU) with the Management Association of the Philippines (MAP) and the National Competitiveness Council to build the capacities of ICT officials in government as well as private-public partnerships (PPP) to assure the utilization of delivery systems for e-governance. In September 2007, the E3 Project selected the Technical Education and Skills Development Authority (TESDA) as the first agency to implement the electronic governance initiatives. In 2008 three other agencies were tapped to improve their business-related processes: the Department of Health, Department of Social Welfare and Development, and National Disaster Coordinating Council.

DTI, CICT, and the Business Processing Association of the Philippines (BPAP, http://www.bpap.org) signed a memorandum of agreement on 22 November 2007 for the creation of an industry standard or scorecard to measure a location's ICT investment viability, and to attract more ICT investments through marketing efforts. The scorecard will serve as a guide to investors. The partners have identified 43 geographical areas, including the so-called 'New Wave Cities' outside Metro Manila and Metro Cebu, to be ranked in terms of ICT-readiness. These partnerships between the government and the private sector are a strategy for sustaining growth of investments in the ICT sector.

LEGAL AND REGULATORY ENVIRONMENT

The Philippine government acknowledges the significance of IT development in the country and its role in social and economic growth by undertaking measures to promote ICT consciousness, build capacity, and provide a conducive ICT environment for business, public administration, services delivery, education, and communications. In a bid to consolidate efforts in this regard, the Philippine executive has moved for the creation of the Department of Information and Communication Technology (DICT) to supercede the Commission on ICT (CICT). The proposal is up for discussion at the Senate, with the House of Representatives having approved on 5 August 2008 the proposal in the form of House Bill No. 4300.

Another piece of legislation that could further strengthen the ICT sector is the Joint Resolution of the Philippine Senate and House of Representatives creating a Commission to review science, technology, and engineering competitiveness. IT and IT-enabled services, and electronics and semiconductors, are among the six sectors to be reviewed by the Commission. The review is expected to lead to recommendations of legislative and executive action that can be taken to improve the competitiveness of these sectors. The resolution establishing the Commission was passed in February 2007 and approved by the president in April 2007.

An important piece of ICT-related legislation adopted in 2007 was Republic Act (RA) 9369, the New Election Automation Law. What is notable about the law is that it adopts a technology-neutral framework with respect to the automation of elections.

In 2008, CICT endorsed to Congress a draft 'Cybercrime Prevention Act of 2008'. The proposed act aims to secure the integrity of computer and communications systems, and to protect the citizenry from rising incidents of illegal, malicious, and life-threatening acts committed through the use of the Internet, mobile phones, and other computer systems or networks. The draft bill defines various forms of cybercrime offenses and prescribes corresponding penalties.

DIGITAL CONTENT

Twenty-five million pages of Filipiniana materials[3] from the collections of the National Library of the Philippines and the libraries of the University of the Philippines System, DOST, and Commission on Higher Education (CHED) have been digitized through the Philippine e-Library Project supported by the e-Government Fund. With some of the collections dating back to the 16th century, the digitized materials form a significant part of the Philippines' cultural, historical, and intellectual heritage.

Other education-related digital content projects are the:

- Open Content in Education Initiative (OCEI), which will convert DepEd materials into interactive multimedia content, develop applications for use by schools, and conduct student and teacher competitions to promote the development of education-related Web content.
- iSchool WebBoard, which will enable teachers to build and share online self-learning materials, and facilitate immediate access to useful references and interactive facilities on the Internet.
- PhEdNet, a 'walled garden' of educational, learning and teaching materials and applications for use by public school students, their teachers and parents. It is called a 'walled garden' because only DepEd-approved multimedia applications, materials and mirrored Internet sites will be accessible from school PCs.
- e-Learning modules in science and mathematics for the elementary school level developed by the DOST Science Education Institute and ASTI, which are being distributed free to public schools. The next phase of the work is for high school science and mathematics.
- e-Learning modules for the Alternative Learning System (ALS), which caters to out-of-school youth and adults. Eighty modules have been completed and about 120 more are due for completion in late 2008 and early 2009.

ONLINE SERVICES

As of the first quarter of 2008, 286 of 306 national government agencies (NGAs), or 93.5 percent, have a Web presence. In terms of the United Nations-American Society for Public Administration (UN-ASPA) stages of e-government, 14 NGAs (4.9 percent of those with a Web presence) are at Stage 4, characterized as 'Transactional Web Presence', where users are able to conduct complete and secure transactions online. The rest of the NGAs with websites are classified as follows: 35.31 percent are at Stage 3; 41.96 percent are at Stage 2; and 17.83 percent are at Stage 1.

Fully operational online government services to date include Land Transportation Office (LTO) licencing, National Statistics Office (NSO) civil registry certifications, Government Service Insurance System (GSIS) delivery of services and benefits to members, Security and Exchange Commission (SEC) registration and monitoring, and Bureau of Internal Revenue (BIR) online filing and payment for large corporate taxpayers. Other online services will soon be operational with the completion of the government's payment gateway.

A key online service is the e-Payment Gateway called 'eBayad'. Citizens can make electronic payments to government agencies using credit cards, debit instructions, and mobile wallets through this Internet-enabled payment portal.

eSerbisyo is the Philippine government's e-Services Portal with the motto 'bringing government closer to the people'. It is designed as a one-stop, citizen-centric, business-friendly front-line service-focused portal for accessing comprehensive information and government services. eSerbisyo has two reliable Internet Service Providers (ISPs) to handle multiple users at any one time. The service includes 'how to' and downloadable forms, public information, data about the Philippines, e-groups, feedback, job lists, and weather alerts. The eSerbisyo Pass is the citizen's single account to transact with government online using one username and password, while eSerbisyo Search allows him/her to look for specific content across all government websites in the portal.

Other e-government services have been developed though the e-Government Fund. These include:

- The BIR's Integrated Computerization Projects, including the electronic filing and payment system and BIR Data Warehouse.
- The NCC's Jumpstarting Electronic Governance in Local Government Units (eLGU) Project, which assists LGUs in the computerization of priority revenue-generating systems and the establishment of CeCs.
- The Food and Nutrition Research Institute's e-Nutrition Project, an automated Internet-based knowledge centre that will allow the electronic dissemination and utilization of nutrition survey data and results.
- The Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA)'s Interactive Climate and Weather Information Network (PICWIN) Project, which seeks to establish an interactive-based weather-related information system using cellular technology.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING

In an increasingly technology-oriented and globalizing world, the use of ICT has become a critical factor in enabling more people to gain an education, which in turn ensures that a country's workforce is skilled and prepared to meet the challenges of development. Thus, ICTs are now part of Philippine basic education, workforce competency and capacity building, and special needs education.

In the basic education sector, CICT's i-Schools Project has equipped some 4,490 public high schools in the Philippines with

i-Schools Learning Resource Centers (iSLRCs) from 2005 to date. An iSLRC is a wireless Internet laboratory that includes 10–20 Internet-ready computers, a liquid crystal display (LCD) projector, a computer printer, and two air conditioning units. To ensure appropriate use of these laboratories, school heads and teachers underwent a series of workshops on ICT integration in teaching and learning. Regular monitoring and evaluation activities are being conducted to ensure project sustainability.

The iSchools project complements the private sector-led Gearing up Internet Literacy and Access for Students (GILAS) program that has equipped about 2,020 public high schools with free Internet access and 10 computers per school.

The latest ICT-assisted basic education initiative is the eSkwela Project,[4] a CICT flagship project that aims to make out-of-school youth and adults globally competitive through the effective use of ICT in alternative learning. The eSkwela centres serve as venues where learners and other community members can gain literacy and life skills and competencies; develop new skills, including digital literacy; review for the Accreditation and Equivalency (A&E) Exam of the DepEd Bureau of Alternative Learning System; and/or prepare themselves to rejoin the formal school system. Five eSkwela centres have been established so far, each with around 20 networked computers, relevant peripherals, Internet connectivity for one year, and a customized learning management system. A major component of the eSkwela project is the development of more than 200 e-learning modules based on the ALS curriculum and the training of ALS instructional managers and mobile teachers in ICT-supported teaching and learning.

The Workforce Mobilization Program (WMP) is a partnership between CICT, CHED, the Technical Education and Skills Development Authority (TESDA) and private training institutions that aims to match workers to jobs and vice versa. A subprogram of the WMP is the 'Near Hire' scheme, which upgrades participants' skills to the level required for hiring by ICT firms. At the same time, the curriculum of higher education institutions (HEIs) is being reviewed and courses revised or developed to improve the competencies of graduates, including proficiency in spoken English, a core competency for the global BPO market.

In addition, WMP authorities are formulating the ICT competency standards and preparing the competency-based certification examinations to professionalize ICT human resources in the Philippines.

Other ICT-related capacity building programs in 2007–2008 are:

- The e-learning and/or technology-based distributed learning programs of open universities such as the University of the

Philippines Open University and the Polytechnic University of the Philippines Open University;

- The University of the Philippines IT Training Center, which has about a hundred graduates per year in its one-year post-baccalaureate IT training program and about 1,000 trainees in its one-two week IT training courses;

- TESDA's skills upgrading programs, which upgrade the competencies of IT graduates to enhance their chances of being absorbed by the IT and IT-enabled services industry, and training programs for individuals to gain ICT skills for purposes of employment;

- IT training programs for higher education teaching staff of the Philippine State Universities and Colleges Computer Education Society (PSUCCESS), Philippine Society of IT Educators, Computing Society of the Philippines and Philippine Computer Society;

- The Philippine National IT Standards (PhilNITS) Foundation's training courses for professionals from different industry sectors on 'Fundamentals of IT', with the support of DTI and Japan's Ministry of Economy, Trade and Industry;

- The Information Technology Foundation of the Philippines (ITFP)'s Philippine-Australia Quality Technical Vocational Education and Training Project (PAQTVET II);

- Training programs by the Cebu Educational Foundation for IT (CEDFIT) to increase the absorption rate of college IT graduates in industry; and

- Brain-Gain Networking's program to bring Filipinos overseas back to the country and help upgrade the competency of local talents, including those in the ICT fields.

Through a Mutual Recognition Agreement between PhilNITS and the Japan IT Engineers Examination Center (JITEC) of METI, PhilNITS gets technical support from JITEC in implementing the Fundamentals of IT Engineer (FE) Certification Standards and Software Design and Development (SW) Certification Standards. Technical assistance from the Japan External Trade Organization (JETRO) comes in the form of training facilities for the PhilNITS offices in Manila, Cebu, and Davao and the assignment of technical experts. There are scholarship and training grants from the Association for Overseas Technical Scholarships (AOTS) and provision of an e-learning system (hardware, software, and content modules) from the Center of the International Cooperation on Computerization (CICC). From 2003 to 2007, PhilNITS trained around 1,606 IT professionals and teachers locally and sent 124 scholars to Japan for training. From 2002 to April 2008, PhilNITS certified 573 IT professionals out of 4,852 registered examinees for the FE exams, and 15 out of 30 examinees for the SW Certification Exam.

The eCare Centers are specially designed to provide access and training programs for persons with disabilities (PWDs). The target is to establish one eCare centre in each region. The Philippine Web Accessibility Group (PWAG)'s program promotes Web accessibility for all, including PWDs.

These programs are covered in the ICT in Education Masterplan, which includes a National Roadmap for Faculty Development on ICT in Education and a National Framework Plan for ICTs in Basic Education (2005–2010).

ICT AND ICTD RESEARCH AND DEVELOPMENT

The DOST has included ICT as one of its five priority R&D areas in 2007–2010. Some of the concerns being addressed are providing rural communities with wider access to information, better delivery of essential information on disaster mitigation, and ensuring better performance of computer networks for R&D operations, generating innovations for technology-based entrepreneurship and improving governance.

ASTI in particular is engaged in advanced network research, research on wireless technologies and network applications, and software development. One of its projects is the Philippine e-Science Grid Program, which focuses on building a grid infrastructure for collaborative research activities by education and research institutions, and advanced distributed services by national institutions. For example, an application of grid computing in the Bioinformatics and Federated Geospatial Information System (FedGIS) provides thematic spatial data overlaid on base maps of the National Mapping and Resource Information Authority for use in hazard mapping and assessment. Partner institutions and independent researchers can use grid facilities for high performance tasks such as numerical modelling, protein folding, deoxyribonucleic acid (DNA) sequence assembly and alignment and computer animation rendering, as well as complex administrative tasks such as cross-institutional federated identity authentication and authorization and grid management.

The ICT for the Environment Program aims to develop cost-effective platforms and applications for real time monitoring and forecasting of environmental parameters.

Microelectronics and Embedded Systems R&D aims to promote technology awareness and establish the design foundation and expertise vital for the Philippines to enter the global market for integrated circuits (IC). It cultivates a skilled workforce adept in IC design and equipped for quality R&D work through training and exposure to actual design work.

The PREGINET Communities of Practice (CoP) project supports virtual networks of individuals and organizations

with a common interest in and commitment to developing and applying ICT in specific sectors or thematic areas to create socio-economic development impact. It builds on the knowledge resources and infrastructure of a wider set of stakeholders and targets other priority sectors, such as environment, education, and governance. Stakeholders will find these CoPs a safe and fertile venue for dialogue, knowledge exchange, and collaborative partnerships.

The Technology Transfer Program uses R&D for enterprise development and capability enhancement of industry and academe. Productivity enhancement and capacity building for the local electronics sector, particularly the small and medium-sized enterprises (SMEs), is given priority.

DOST's ICT4D project, which is supported by the International Development Research Centre of Canada, has yielded two case books that describe ICT projects in local governance, health, education, commerce, and other socially oriented programs that have benefited women, the poor and the less educated. Learning points collected from the cases have been brought to the attention of legislators, key policymakers in government, and stakeholders from the private sector for appropriate action.

OPEN SOURCE AND OPEN CONTENT INITIATIVES

Open source software (OSS) advocates from various sectors met at the 2008 Philippine Open Source Summit to discuss the development of an innovation ecosystem and the promotion of technology entrepreneurship. Open content and OSS in the Philippines is supported by the following NGOs:

- Philippine Linux Users Group (PLUG)
- UnPLUG, the University of the Philippines Linux Users' Group that has developed an open source application for student elections
- Advanced Software Foundation Inc., which supports ASTI's OSS development efforts
- Diliman Computer Science Foundation, which handles training, consultancy, and services in use of OSS
- DabaweGNU, Inc., a non-stock, non-profit organization based in Davao City that promotes open source technologies
- Pampanga Open Source eXchange (POSX), a budding community of OSS users, developers, and enthusiasts within and around the province of Pampanga

OSS development programs include the Java Education and Development Initiative (JEDI) of the University of the Philippines

that, in cooperation with Sun Microsystems, has developed open source software for around 15 courses in Computer Science. The software have been translated to Portuguese and Bahasa Indonesia and are now being used by about 1,000 IT instructors in the Philippines and Indonesia.

The Bayanihan Linux Version 3.1 (www.bayanihan.gov.ph) developed by professionals of ASTI's Open Source Group is interoperable with MS Windows machines on a network. It is secure and nearly virus-proof and has a desktop operating system and office productivity suite.

Most e-government projects funded by the e-Government Fund utilize open source software. One of the earliest examples is the e-NGAS, a computerized version of the government accounting system aligned with international accounting standards (IAS)/international Financial Reporting Standard (IFRS) and developed using OSS.

During the National Innovation Summit in November 2007, the DOST and PEZA entered into a partnership for an Open Technology Business Incubation Program that aims to nurture start-up or growing enterprises using open software, open content, and open standards.

The Arellano University School of Law in Manila launched the Philippine version of the Creative Commons (CC) licence in January 2008. The initiative recognizes the need for a CC licence that is adapted to Philippine law for it to be enforceable and capable of giving citizens appropriate protection.

Public Domain Content is espoused by a partnership among CICT, the UNESCO–Philippines Commission, and Intel Philippines.

CHALLENGES AND OPPORTUNITIES

Although there have been significant gains in the Philippine ICT sector in 2007–2008 as a result of various programs and projects by the government and the private sector, a number of challenges need to be addressed and opportunities leveraged to ensure that the gains redound to the good of all citizens.

A persistent challenge is the need to ensure universal access to ICTs and ICT-enabled development. Communications infrastructure must be built on principles of fair competition as well as public and universal service. To ensure that benefits are extended to all social and economic groups, investment in the ICT sector should focus on capacity-building that is responsive to local needs, especially those of marginalized communities and indigenous groups. Access to and use of ICT must be planned for inclusion of persons with specific needs and requirements. In general, ICT programs of government and civil society need

to address issues relating to human rights in the information society within a framework of non-discrimination and gender equality.

Human capital development is another challenge. The mismatch between ICT education and skills development and industry requirements needs to be addressed through curriculum change and ICT integration. The brain drain of highly skilled ICT professionals may be avoided with improvements in salaries and other benefits in the local ICT sector.

Rampant software piracy is a huge drawback to further development of the local ICT sector. According to the BPAP, reducing software piracy from its current level of 71 percent to 61 percent could double the growth of the IT sector in one year, from USD 1.1 billion today to USD 2.1 billion by 2009. Cutting the piracy rate could add USD 470 million to the economy, create nearly 2,200 new IT jobs, and increase local industry sales by USD 325 million. For the Philippine government, it could mean an additional USD 25 million in tax revenues.

The e-Commerce Law (RA 8792) passed on 14 June 2000 is the nation's lone cyber law. It complements the Intellectual Property Rights Act, the Consumer Act and the Revised Penal Code. Other proposed measures against computer fraud, forgery and sabotage, damage to computer data or programs, unauthorized access to or interception of computer data, data or system interference, and unsolicited commercial communications are still pending. Addressing this gap in the legal environment will build greater confidence in the use of ICTs and enhance the free flow of information and knowledge.

A fifth challenge is how to ensure and sustain the participation of civil society in the information society at all levels, from policy planning to implementation, monitoring, and evaluation. The government needs to ensure that market competition is fair and that monopolies are not perpetuated. While promoting local content development and ensuring that the new technologies are not used for criminal gain, government should not be a regulator of information flow and content. Privacy needs be protected and surveillance and censorship must not threaten human rights, democracy, and freedom of expression.

In striving to meet these challenges, stakeholders in the ICT sector can take advantage of a number of opportunities, such as ICT entrepreneurship, particularly in the development and utilization of ICT-enhanced innovations that will lead to economic stability; the promotion of revenue generation through strategically located ICT industries throughout the country; and PPPs in local content development and applications in art and culture. The Philippines is already a major player in the global ICT market, particularly in e-services. This position needs to be strengthened and consolidated into a Philippine brand that evokes quality, innovation, and world-class sophistication, and gives Philippine companies a competitive edge.

NOTES

1. Bayan Telecommunications through BayanDSL ADSL offers from 768 Kbit per second to 2.5 Mbit per second, and through ZPDee cable Internet from 64 Kbit per second to 1 Mbit per second. ETPI SDSL offers from 256 Kbit per second to 2 Mbit per second. Global Destiny Cable Destiny Cable SDSL services provides up to 3 Mbit per second. Globe Telecom, through its subsidiary Innove offers ADSL from 512 Kbit per second to 2 Mbit per second. PLDT offers ADSL from 384 Kbit per second to 5 Mbit per second. Smart Communications offers wireless fixed broadband at 384 Kbit per second. In 2008, the latter has become available in pre-paid mode through the use of a USB modem where users can purchase load/credit at different handphone loading centres.

2. The *barangay* is the smallest administrative unit in the Philippines. Each municipality is made up of several *barangays*.

3. Some 900,000 pages of historical pictures, rare maps, presidential manuscripts, Philippine insurgent records, and rare newspapers and journals have also been digitized.

4. 'eSkwela' is a play on the Filipino word for school ('eskwela') and 'e-school' (electronic school).

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.sg

Singapore

Goh Seow Hiong

Total population	4,588,600 (2007)[a]
Literacy rate	95.4% (2006) (among residents aged 15 years and over)[a]
GDP per capita	SGD 52,994 or USD 38,349.07 (2007) (1 USD = 1.38188 SGD)[a]
Computers per 100 inhabitants	72.61 (2006)[b]
Fixed-line telephones per 100 inhabitants	40.6% (January 2008)[c]
Mobile phone subscribers per 100 inhabitants	125.6% (January 2008)[c]
Internet users per 100 inhabitants	Dial-up only: 22.8% (January 2008)[c] If (dialup subscriptions + broadband subscriptions)/population: (1,047,000+3,396, 000)/4,588,600 = 96.83% (January 2008)[c]
Domain names registered under .sg	852,520 (January 2008)[d]
Broadband subscribers per 100 inhabitants	74% (January 2008)[c]; Household penetration 78.2% (January 2008)[c]
Internet international bandwidth:	Submarine cable capacity: 28 Tbps (October 2007)[c] Direct international Internet connectivity: 25 Gbps (October 2007)[c]

(Sources: [a]SingStat 2008a; [b]International Telecommunication Union 2008; [c]IDA 2008u; [d]Internet Systems Consortium 2008)

OVERVIEW

Singapore's Gross Domestic Product (GDP) was SGD 209,990.9 million in 2006, with a per capita GDP of SGD 46,832 (SingStat 2008a). The bulk of this comes from manufacturing, construction, utilities, wholesale and retail trade, hotels and restaurants, transport and communications, financial services, and business services.

Revenues in information and communication or infocomm technology (ICT) reached SGD 45.4 billion in 2006, an annual growth of 19.9 percent. Thirty-six percent of this was domestic, while 64 percent was export-oriented. Seventy-eight percent of households had access to a computer and 71 percent had access to the Internet in 2006, up from 74 percent and 66 percent respectively in 2005. The proportion of businesses with broadband access was 99 percent for organizations with 250 and more employees, 83 percent for organizations with 50–249 employees, 69 percent for organizations with 10–49 employees, and 44 percent for organizations with less than 10 employees. The number of infocomm personnel grew 7.5 percent from 111,400 in 2005 to 119,700 in 2006 (IDA 2008a).

As of November 2007, 95 percent of households had fixed-line telephones. Mobile phone penetration is at 116.1 percent, Internet dial-up penetration at 22.8 percent, and household broadband penetration at 76.9 percent (IDA 2008b).

The Singapore economy continues to grow, developing a highly competitive ICT market, attracting substantial foreign investment, and becoming the regional headquarters of international players. Singapore continues to redefine itself and find new and innovative niches to maintain an advantage amidst increasing competition from neighbouring countries with lower operating costs for companies. The presence of local

and international players interacting in a freely competitive environment is a key characteristic of the country's continued success.

TECHNOLOGY INFRASTRUCTURE

Since articulating the Singapore iN2015 Masterplan to transform Singapore into an intelligent nation and global city powered by infocomm by 2015, the government has taken steps to realize the Next Generation National Infocomm Infrastructure (NGNII) consisting of the Next Generation National Broadband Network (NBN) and a wireless broadband network that includes *Wireless@SG*, a program for establishing free Wireless Fidelity (WiFi) access island-wide.

A Request for Proposal (RFP) was issued in December 2007 for parties to design, build, and operate the *passive* infrastructure of the Next Generation NBN intended to provide pervasive high-speed connectivity for both business and home users. Effective open access to downstream operators is at the core of this RFP. As a policy, there will be structural separation of the passive network operator from downstream operators. The Singapore government is prepared to provide a grant of up to SGD 750 million for the project. The infrastructure is expected to be fully available nationwide by 2015, supporting a range of new services such as high-definition video conferencing and telemedicine.

A separate RFP was issued in April 2008 for the operating companies riding on the passive infrastructure and retail service providers. To enable downstream service providers to have effective open access to the operating company's *active* infrastructure

of the Next Generation NBN, the RFP will require the operating company to be operationally separated from other operators. The Singapore government is prepared to provide a grant of up to SGD 250 million to the successful bidder. With the grant for the network operator mentioned above, the total grant the Government is prepared to provide for the Next Generation NBN is SGD 1 billion (IDA 2008c, 2008d, 2008v).

Complementing the Next Generation NBN is a Wireless Broadband Network in key catchment areas. Part of this effort is the *Wireless@SG* initiative (discussed in the next section). Several other complementary services are envisioned and a Call-For-Collaboration for Wireless Broadband Market Development has been initiated to look into several areas, including mobile payments (m-payment), machine-to-machine or wireless sensor networks, telematics (merging of automotive and telecommunications technology), and location-based services (IDA 2008e).

A milestones achievement in 2007 was the rollout of High Speed Downlink Packet Access (HSDPA) by mobile operators. HSDPA builds on the third generation (3G) network to offer wireless access at speeds of 3.6 Mbps, and up to 7.2 Mbps for certain hardware. The ready availability of handsets, portable digital assistant (PDAs), and computers with built-in HSDPA capabilities means even greater seamless network and data access for consumers on the move (ZDNet Asia 2006a). Individual mobile operators are also entering into agreements with other mobile operators in the region to offer reduced rates or even flat rate mobile data access across countries. Bridge Alliance's DataRoam service, for instance, offers a flat rate for data roaming across Australia, Hong Kong, India, Indonesia, Korea, Macau, Malaysia, the Philippines, Singapore, Taiwan, and Thailand with select operators (SingTel 2008).

Launched in December 2006, *Wireless@SG* aims to blanket Singapore with free WiFi access with over 7,000 hotspots to improve infrastructure and public access to the Internet. Users can enjoy free indoor and outdoor wireless broadband access of up to 512 Kbps in most public areas. The objective is to serve 'people on the move' or people who require broadband access while away from home, schools, and offices, such as students, tourists, business travellers, and enterprise users like insurance agents and real estate agents. Users can register an account with one of the appointed wireless operators, and they will be able to roam within any of the *Wireless@SG* coverage areas in a seamless manner, regardless of the operator's network (IDA 2008f).

Wireless@SG is to be provided free for the first three years. The program is very well received, with more than 750,000 signed-up subscribers by April 2008. It has also earned the international Wireless Communities Best Practices Award of the Wireless Internet Institute, under the 'Economic Development' category (WII 2008; ZDNet Asia 2008).

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The key institutions dealing with ICT in Singapore are:

- The Infocomm Development Authority of Singapore (IDA, www.ida.gov.sg) is the infocomm industry champion, the national infocomm master planner and developer, and the government CIO. Its strategic goal is to attract foreign investment and sustain long-term GDP growth through innovative infocomm technology development, deployment, and usage, in order to enhance the country's global economic competitiveness.
- The Media Development Authority of Singapore (MDA, www.mda.gov.sg) has a dual function: *(i)* to promote the growth of the media industry; and *(ii)* to manage content to protect core values and safeguard consumers' interests. Its long-term objective is to develop Singapore into a vibrant global media city, a creative economy, and a connected society.
- The Interactive Digital Media (IDM) Programme Office (www.idm.org.sg) is responsible for managing the SGD 500 million budget allocated by the National Research Foundation for the development of a strategic IDM research program. Its efforts include developing a critical mass of media enterprises and talents, internationalization of local IDM content and enterprises, and strengthening Singapore's role as a Digital Exchange to process, manage, and distribute digital assets. The IDM Programme Office is housed within MDA and is a multi-agency effort.
- The Ministry of Information, Communications, and the Arts (MICA, www.mica.gov.sg) aims to develop Singapore as a global city for information, communications, and the arts in order to build a creative economy, a gracious community, and a connected society with a Singaporean identity rooted in the people's multicultural heritage. The MICA is the supervising ministry for the IDA and the MDA.
- The Singapore Infocomm Technology Federation (SiTF, www.sitf.org.sg), Singapore's premier infocomm industry association, brings together 400 corporate members from multinational and local companies. Members receive assistance in business development, market intelligence, overseas trade missions, and networking and alliances. Its mission is to realize a profitable Singapore infocomm

industry with worldwide reach and recognition, by working with government agencies, other local trade associations, and international organizations.

- The Economic Development Board (EDB, www.edb.gov. sg) is the lead government agency for planning and executing economic strategies to enhance Singapore's position as a global hub for business and investment. It is a one-stop agency, supporting local and foreign investors in manufacturing and services as they seek more value-creating operations, higher sustainable returns, and new business opportunities. The infocomm and media sector is one of the industry sectors covered by the EDB.

In addition, Singapore universities and polytechnics each have a school of infocomm providing training and developing the pool of human resources needed by the industry.

ICT AND ICT-RELATED INDUSTRIES

Singapore has a diverse ICT industry consisting of companies specializing in hardware, software, IT services, telecommunication services, and content services. The industry's total revenue in 2006 was SGD 45.42 billion, a 19.9 percent growth from 2005. The hardware sector accounted for 53 percent of the total.

The domestic market was SGD 16.44 billion in 2006, representing a modest growth of 3.9 percent from 2005. There were revenue increases in all segments except telecommunication services and hardware. Telecommunication services account for the highest share in total revenues (33 percent in 2006, down from 41 percent in 2005), followed by hardware (25 percent in 2006, down from 29 percent in 2005). There were increases in the revenue share of software (from 4 percent in 2005 to 10 percent in 2006), IT services (from 16 percent in 2005 to 18 percent in 2006), and content services (from 10 percent in 2005 to 13 percent in 2006).

The bulk of infocomm industry revenues in 2006 came from the export market (64 percent), which grew by 31.4 percent, earning SGD 28.98 billion compared to SGD 22.06 billion in 2005. The hardware segment dominated the sector with 69 percent of the export revenue in 2006. Software revenue comprised 22 percent, IT services 5 percent, telecommunication services 3 percent, and content services 1 percent. Thirty-Seven percent of export revenue came from exports to North Asian countries, and 19 percent to the Association of Southeast Asian Nations (ASEAN) countries (the largest were 37 percent to Malaysia and 18 percent to Indonesia). Exports to Japan made up 33 percent, the highest proportion of export revenues in Asia, followed by India at 17 percent. In the Middle East, the highest proportion of exports was to the United Arab Emirates at

61 percent, while in the Americas/Europe, 43 percent of exports was to Western Europe, 27 percent to the United States (US), and 26 percent to Eastern Europe (IDA 2008g).

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Infocomm Adoption by SMEs

IDA's *Infocomm@SME* Programme aims to help small and medium-sized enterprises (SMEs) better exploit infocomm technologies through various initiatives such as:

- The SME Infocomm Resource Centre @ Singapore Polytechnic (SIRC@SP) aims to assist SMEs in the use of common software such as electronic mail, Internet voice, anti-spyware, anti-virus, and a wireless network setup. The centre offers businesses the opportunity to experiment with new systems and products before taking the decision to implement them.
- The Technology Innovation Programme (TIP) seeks to defray up to 50–70 percent of the cost of infocomm innovation of SMEs. SGD 5 million was set aside to help with business costs related to human resources, professional services, and hardware and software. Individual enterprises and groups may apply for support.
- Website creation services aim to encourage businesses to establish an online presence. Registered businesses will be able to save on the first year registration cost of Internet domain names.
- The Local Enterprise Technical Assistance Scheme (LETAS) can help SMEs with up to 50 percent of the cost of engaging external consultants for infocomm implementation.

Service providers are encouraged to form a consortium offering one-stop infocomm packages to help them operate more efficiently (IDA 2008h).

Digital Inclusion Programs

The NEU PC program is designed to ensure that all students have access to infocomm technology. The program has benefited more than 24,000 financially-challenged households with a monthly income of less than SGD 2,000 or a per capita income of less than SGD 500. Launched in 1999 to provide refurbished and new PCs with one-year free Internet dial-up subscription, the program now offers only new PC bundles. The most recent enhancement under the NEU-PC Plus program gives needy students and people with disabilities a new computer bundled

with three years of broadband access and a software package worth up to SGD 2,800, for only SGD 285. As of February 2009, another 4,200 families have benefited from this most recent enhancement. Those who cannot afford the subsidized cost of the package can co-pay through some form of community service under the iNfocomm Spark an Inspiring and Rewarding Experience (iNSPIRE) Fund contributed by industry and the government. Schools may tap the Ministry of Education's Opportunity Fund to help students own computers required for their school work. Other self-help groups, such as the Chinese Development Assistance Council and Singapore Indian Development Association, offer financial assistance to needy students (IDA 2008j).

Learning hubs called Silver Infocomm Junctions (SIJs) are being established to give senior citizens the opportunity to learn how to use new technologies, for example to make voice-calls over the Internet, meet and chat with friends online, and play computer games. This is part of a three-year Silver Infocomm Initiative aiming to equip 30,000 senior citizens with the infocomm skills necessary for a digital lifestyle. At least eight SIJs are expected to be established over three years.

In addition, an Infocomm Accessibility Centre (IA Centre) was established in mid-2008. Located with the Society for the Physically Disabled, the IA Centre houses an assistive technology library and three computer labs to offer industry relevant technology training and IT-related apprenticeship. The Centre is aims to train about 4,000 people with disabilities in three years, to increase their independence and job prospects (IDA 2008k).

Broadcasting

Commercial high-definition TV (HDTV) was launched in 2007, making Singapore the first country in Southeast Asia to offer such services. HDTV is available via cable and over-the-air terrestrial broadcast.

MDA is now working with industry to rollout broadcast TV on mobile phones — i.e. mobile TV services (MTVS).[1] Issues being considered include technical standards and quality of service requirements, licencing framework (kinds of licences to be issued), market structure (number of operators), and content and advertising regulation — i.e. the extent to which regulation of content should differ from regular free-to-air and subscription broadcast (MDA 2008b).

National Grid

The National Grid Pilot Platform (NGPP) has been established to facilitate computing-intensive services not only for the research and development (R&D) community but also for public agencies such as libraries and schools. The Grid is used for such applications as the Singapore Land Authority's land data hub and the National Library Board's Web Archive Singapore (WAS), an archive of snapshots of some 70,000 Singapore-registered websites with historical, heritage, and informational value. The grid provides the computing and processing resources to index and archive the pages. There are plans to take a snapshot of the entire Singapore Web domain in the near future. Students at Raffles Institution have also drawn on the power of the grid to develop AutoDock, a popular simulation-based application used in the drug development cycle. The Grid offers a cost-effective means of solving high-performance computing problems (IDA 2007).

Infocomm Security

Since the announcement of Singapore's Infocomm Security Masterplan in 2005, an Infocomm Security Health Scorecard has been introduced to help government agencies improve their overall infocomm security strategies and processes. Work on the Cyber-WatchCentre, which continuously monitors cyber threats to critical government infrastructure in real-time, has also begun. A first in Asia, the Cyber-WatchCentre will allow government agencies to better anticipate cyber attacks and respond more quickly to threats.

In April 2008, a new five-year Infocomm Security Masterplan was unveiled. It comes with a SGD 70 million budget to strengthen the local infocomm security industry's capacity to counter cyber threats. Priorities include raising the standards of infocomm security professionals through accreditation, certification, and training through a new Association of Information Security Professionals. It is recognized that there is a need to build on existing efforts to collaborate internationally, and enhance the exchange of knowledge and regular communication between governments on cyber threat trends and the protection of critical infrastructure. The NGNII security issues will need to be addressed, to create a secure and trusted environment for the pervasive adoption of online services (Business Times 2008b; IDA 2008l).

Government Standard Operating Environment

To help consolidate government procurement for infocomm services, the Singapore government announced in 2005 a Standard ICT Operating Environment (SOE) tender, which aims to standardize equipment across the entire government (including schools and statutory boards but excluding the Ministry of Defence) into a single collaborative environment.

Major vendors, both local and global, have come together to form consortiums to bid for the project (ZDNet Asia 2006b). The SGD 1.3 billion tender was awarded in February 2008 to oneMeridian, a consortium led by EDS International with partners including Alcatel-Lucent, Avanade, Cisco Systems, Frontline, Microsoft, Singapore Computer Systems, and SingTel. The project, envisioned to save the government some SGD 500 million over the next eight years, will be fully implemented by 2010 (IDA 2008t).

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Spam

While general laws can be relied on to address problems created by spamming activities, there are always going to be loopholes that will invariably let undesirable spam through the net. To combat this, Singapore has enacted the Spam Control Act (see 'Singapore Spam Control Act 2007'). Its passage brought about

an almost immediate change in the behaviour of marketers who use the Internet for outreach. They now label their messages as required by the law, and provide opt-out options. Internet service providers (ISPs) have policies for suspending email accounts from which spam originates. Consumer education seeks to raise awareness about how to avoid and counter spam. An informational website called the Singapore Spam Control Resource Centre (www.antispam.org.sg), supported by the IDA, the AGC, ISPs, and other industry associations, also consolidates a list of anti-spam resources, helping business and consumers fight spam.

Cybercrime

Criminal cases relating to the unauthorized use of unsecured wireless networks have been prosecuted in Singapore. In one case, the accused connected to his neighbour's unsecured wireless network (also known as 'wireless mooching') to chat online. He was charged under the Singapore Computer Misuse Act (CMA 1993). His arrest resulted from a complaint filed by

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Singapore Spam Control Act 2007

The Spam Control Act (SCA) prohibits the use of dictionary attacks (defined in the Act as the method by which the electronic address of a recipient is obtained by using an automated means to generate possible electronic addresses by combining names, letters and other symbols in numerous permutations) or address harvesting software (defined in the Act as software designed or marketed for searching on and collecting from the Internet electronic addresses) to indiscriminately send unsolicited email.

With regard to unsolicited commercial electronic messages, the SCA sets out in Schedules the requirements that a sender must comply with, namely:

- Every unsolicited commercial electronic message needs to contain an 'unsubscribe' facility (e.g. contact information to submit an 'unsubscribe request').
- Every unsolicited commercial electronic message must contain the label '<ADV>' in the subject field or start of the message.

The SCA provides for civil actions to be taken against anyone (including those aiding or abetting) who sends electronic messages through the use of dictionary attacks or address harvesting software, or who sends unsolicited commercial electronic messages without complying with these requirements. An exception is provided for online or network access providers who merely provide connections for the transmission of data.

Anyone who has suffered a loss or damage as a result of spam may initiate civil action. An injunction may be granted by a court as a relief, or damages may be awarded based on the actual loss or damage suffered as a direct or indirect result of the action. The law also provides statutory damages of SGD 25 for each electronic message sent, not exceeding an aggregate of SGD 1 million, unless the actual loss is proven to exceed SGD 1 million.

The law also requires Internet access and telecommunication service providers to issue a code of practice indicating the minimum standards for technical measures to control the sending of unsolicited commercial electronic messages.

(Source: Government of Singapore 2007)

a passer-by who became suspicious of the teenager sitting by the road using his laptop late at night. The accused was sentenced by the district court to 18 months' probation (Channel NewsAsia 2007).

In another case, the accused posted an online bomb hoax while connected to a neighbour's wireless network. The message posted on a popular technology website stated that that there was a bomb at a local bus depot. The post was made just after the London subway and bus bombing in July 2005, causing alarm to other users of the site and prompting one of them to contact the police. The police identified the owner of the compromised wireless network, but later ascertained that the owner was not the author of the hoax. The accused also faced 60 charges of tapping illegally into nine unsecured wireless Internet networks over a period of eight months. The accused was sentenced to three months' imprisonment and fined SGD 4,000 (ZDNet Asia 2007a).

These two cases illustrate that the Singapore Police treat unauthorized wireless access seriously. They have said that they do not specifically track such offences but will investigate any allegation of cybercrime when it is reported.

Telecommunications

A Code of Practice for premium rate services over the public telecommunication network (e.g. mobile phone wallpapers, ringtones, and news alerts) has been issued. The code seeks to establish responsible business practices, define appropriate behaviour, and enhance consumer confidence. For instance, the cost of chargeable short message services (SMS) needs to be clearly indicated, and non-chargeable messages need to be sent to consumers to confirm subscriptions and remind them about charges. In addition, the IDA has issued a consultation paper on the industry structure for next-generation access networks, seeking views on the scope of separation, particularly in terms of types of operator, network elements, markets, or other differentiation (Business Times 2008c).

True number portability is expected to be in place in 2008 with the Central Database Administration of all numbers appointed. The central database will encourage new players and new opportunities, giving consumers greater choice and flexibility in mobile and fixed line services. SGNIC, the national registry for Internet domain names, has also started to allow pure numeric domain names, such as 1234.sg (IDA 2008l).

The Singapore government is seeking to promote nationwide IPv6 transition through the inclusion of IPv6 elements in the NGNII, government procurement policies, and industry capability building, thus (IDA 2006):

- The Next Generation NBN will need to support emerging next generation services and incorporate Internet Protocol version 6 (IPv6). Networks to be deployed will need to interoperate with new and existing infrastructure to enable a seamless end-user experience.
- The government as a major buyer will be a key catalyst of the transition to IPv6. A progressive replacement of public sector equipment with IPv6 capable equipment will be undertaken when the current equipment is due for replacement. In view of the expected tight supply of Internet Protocol version 4 (IPv4) addresses, 2010 has been set as the deadline for full public sector transition to IPv6.
- A national IPv6 Task Force with relevant experts from government, industry, and research institutes will recommend a technical transition plan for migrating from IPv4 to IPv6, as well as facilitate a broader understanding of the benefits of IPv6 and develop industry capability in IPv6 technologies.

IP Television (IPTV)

A new licencing framework for Internet Protocol Television (IPTV) has been instituted by the MDA in anticipation of the rollout of commercial IPTV services and to facilitate the growth of the sector. IPTV allows video or television signals to be transmitted over an Internet-based infrastructure and a set top box connected to the television. There are two tiers in the new framework:

- Nationwide Subscription TV Licence — for services that have a wide reach and impact beyond 100,000 subscribers. The Nationwide Licence is similar to that for a mass market pay TV operator.
- Niche Subscription TV Licence — for services that have limited reach and impact (100,000 subscribers or less). A lighter licence framework will be applicable to such licencees. For example, there will be no requirement to carry the local free-to-air channels. Services with a subscriber base exceeding 100,000 subscribers may still qualify as a niche player if they are targeting niche market segments. They will be assessed on the basis of location (whether the service is offered to specific non-residential locations in Singapore), language (whether there is a high proportion of foreign language content), and the reach and impact of the channels.

The licencing framework is intended to allow for more players to enter the market to offer more diverse forms of

programming content for both mass and niche audiences. The framework offers flexibility, which is expected to be more business-friendly (MDA 2008c).

DIGITAL CONTENT

Online Gaming

Singapore continues to recognize the value of developing an online gaming industry, estimated to be worth about USD 48.9 billion worldwide, with the Asia Pacific region contributing about 40 percent. Singapore's goal is to become a centre for the creation and commercialization of digital media and entertainment technologies, and a global node providing core services for storing, trading, and distributing digital assets. Singapore has more than one million square feet of data centre space available for hosting operations and 28 Tbps of submarine cable capacity connected to more than 100 countries, with a next generation broadband network in the pipeline (MICA 2007).

IDA has initiated the Games Exchange Alliance (GXA) to help companies commercialize their game titles in Asia. GXA has signed a memorandum of intent with various Asia Pacific game associations to facilitate business collaborations among members. It seeks to provide game service providers, publishers, content developers, and solution providers with market access to over 13 key Asian markets, including Australia, China, Hong Kong, India, Japan, and Taiwan. Following the Government's lead, private sector participants such as Razer, a PC gaming peripheral maker, has announced that it will increase its R&D capabilities in Singapore by investing USD 12.64 million over three years (ZDNet Asia 2007c).

The INVIGORATE scheme aims to provide aspiring game developers with funding of up to SGD 25,000 for each project, as well as mentorship with established game studios and publishers. Participants will be provided guidance on core business, design and production management aspects of mobile game development, and assistance in enhancing concepts for deployment. The scheme aims to expand Singapore's talent pool for game development (ZDNet Asia 2007d).

Interactive Digital Media (IDM)

To build the foundation of an ecosystem for IDM, close to a hundred projects were funded in 2007 to create new patents and products, and to nurture researchers and engineers in animation, games, effects, intermediary services of distribution and security of digital media, and 'on-the-move' technologies for reaching and interacting with mobile users. A network of business

mentors has been formed to encourage experimentation with innovative applications and services, with participation from NUS Enterprises, NTU Ventures, FrontEdge Capital, Expara, and Thymos Capital. The network will help start-up companies overcome initial hurdles in getting the business running. Some successes observed include First Meta, a six-month start-up in financial services that was shortlisted for Red Herring 200 Global 2007.

Local flagship media and technology companies, SMEs, and major international companies are also encouraged to create synergies from collaboration, and to engage in R&D. Institutes of higher learning and research institutes are working with local counterparts to attract talents to make the country a centre for Interactive Digital Media (IDM) research and innovation. One success is the Singapore–MIT GAMBIT game lab where Singapore students had the opportunity to intern at the Massachusetts Institute of Technology (MIT) in 2006 to develop games. The China-Singapore Institute of Digital Media is a collaboration with the Chinese Academy of Sciences Institute of Automation (CASIA), which focuses on language mediation technology. The Singapore Ministry of Education has also established an R&D program to fund projects to build the capacity of schools to use IDM for teaching and learning (MDA 2008a).

ONLINE SERVICES

Common Online Identification System

The Singapore Personal Access (SingPass) system first launched in 2003 as a single log-on system for citizens and residents to access a range of government services, was upgraded in 2007 to streamline the log-in process and to allow users who have forgotten their passwords to reset them immediately. Transactions using SingPass increased more than threefold in four years from 4.5 million in 2003 to 18.9 million 2006. Previously administered by the Central Provident Fund, a government agency, the system will be managed by the private sector henceforth, although ownership will remain with the government with safeguards to ensure smooth running and confidentiality of user information (IDA 2008m).

EzCode

EzCode is an IDA initiative to give government, the private sector, and the public a free and secure two-dimensional (2D) barcode platform on a pilot basis. It allows camera-equipped mobile phones with downloaded software to easily decode 2D

barcodes, which contain more information than one-dimensional barcodes.[2] The decoded 2D barcode will then lead a user to online resources containing more detailed information. The technology has a wide range of applicable uses, including ticketing (e.g. printed with posters in mail and newspapers), location-based services (e.g. located at bus and taxi stands for schedule and bookings services), information discovery (e.g. outdoor advertising), payment (e.g. bills), and identification verification (EzCode 2008).

Mobile Payment

A range of different mobile payment (m-payment) and m-commerce providers are already in the market, but they are engaged in uncoordinated efforts using a variety of technologies from SMS to Java 2 Micro Edition (J2ME) applications. To avoid an unduly fragmented market that may dilute end-user experience, and to address potential issues relating to settlement, security, bad debt and repudiation, the Singapore government is seeking information from the industry on its capabilities and the possibility of converging local payment acceptance through a unified standard (CEPAS) for proximity payments. This is being undertaken under the broader Call-for-Collaboration for Wireless Broadband Market Development — described earlier (IDA 2008e).

Cluster Development Programs

As part of the iN2015 Masterplan, various cluster development projects have been deployed to transform key economic sectors by leveraging on infocomm. A project in the tourism, hospitality, and retail sector is the Digital Concierge program (www.digitalconcierge.sg), a joint effort of the IDA and the Singapore Tourism Board to provide every visitor with personalized information and services through mobile network devices via the cellular network and the *Wireless@SG* infrastructure. The service gives users suggestions on activities, restaurants, shops, attractions, and retail promotions, as well as event updates, based on preferences and location. The pilot project seeks to identify technology and business issues for planning long-term deployment (IDA 2008i).

In the trade and logistics sector, the Wireless-broadband-access for SEaPORT (WISEPORT) project will allow all ships in Singapore to have access to low-cost mobile wireless broadband using Worldwide Interoperability for Microwave Access (WiMAX) technology. This will facilitate real-time and data-intensive communications and applications between the ships and their customers and business partners previously possible only onshore. WISEPORT is one of the initial projects

under the SGD 12 million Infocomm@SeaPort program to provide mobile wireless broadband within 15 kilometres of Singapore's southern coastline. Applications being explored under Infocomm@SeaPort, which is a collaboration between the Maritime and Port Authority of Singapore and the IDA, include optimizing car transhipment planning and operations, and automating some of the current labour-intensive processes in the bunker supply chain. A Call-For-Collaboration will be initiated to develop new WISEPORT content and applications for the seaport community, such as messaging and communication services, booking of maritime services, and real-time access to navigational data (IDA 2008n).

Launched in October 2007, TradeXchange is a platform for exchanging information within the trade and logistics community that allows seamless interconnection between commercial and regulatory systems through a single electronic window for integrated workflow, submissions, and enquiries to the seaports, airports, maritime authorities, customs, and other controlling agencies. The new platform has been well-received by the trading community in Singapore. Companies have experienced faster turnaround time and lower costs for declaration preparation and submission, and duplicate data entry has been eliminated, thus resulting in faster clearance and greater productivity. TradeXchange is developed and operated by CrimsonLogic, and builds on their earlier experience of developing TradeNet, the world's first trade documentation system, launched in 1989 (TradeXchange 2007).

For the healthcare and biomedical sector, the Integrated Clinic Management System (CMS), an SGD 15 million four-year program, was launched in September 2007 to encourage general practitioners' clinics to adopt and leverage common standards and interface to facilitate operations and improvements in patient care. To date there are 350 clinics on the CMS program (IDA 2008s).

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

In 2006, the number of infocomm personnel in Singapore reached 119,700, a 7.5 percent increase from 2005. Infocomm job vacancies totaled 2,100 in 2006, with the highest proportion of job categories required in software design, development, and solution implementation (29 percent), followed by database management (15 percent). Forty-six percent of infocomm personnel held a bachelor's degree, 5 percent had a postgraduate diploma, 10 percent had a master's degree, and 1 percent had a doctorate degree. The remaining 39 percent held a diploma or below. The largest proportion of infocomm personnel was

in the age group of 30–39 years old (49 percent), followed by 29 years or below (25 percent) and 40–49 years (20 percent). The top three job categories were infrastructure support (23 percent), software design, development and solutions implementation (20 percent), and infocomm sales and marketing — 15 percent (IDA 2008o).

Having a strong base of infocomm human resources is essential both for developing a domestic industry and encouraging high adoption of technology. The Singapore government aims to increase the number of infocomm jobs from 115,000 to 170,000 by 2015. The focus is on developing infocomm competencies in key economic sectors, developing globally competitive professionals, and attracting and retaining talents. Some of the key programs are (IDA 2008p):

- The CXO Programme seeks to inspire business leaders in key sectors about the value of infocomm through breakfast forums, seminars, and site visits.
- The InSkills@Work Programme aims to equip professionals in all sectors with skills to use technology effectively and productively.
- The Critical Infocomm Technology Resource Programme (CITREP) provides infocomm professionals with training incentives and supports course and examination fees for endorsed courses and certifications. The National Infocomm Competency Framework (NICF) defines the training and certification requirements in an infocomm professional's career.
- The National Infocomm Scholarship identifies and cultivates future industry leaders through scholarships and training opportunities with leading companies.
- The Infocomm Clubs Programme for schools aims to create interest in students from a young age through training, project work, mentorship, competition and collaborations between schools.
- The National Infocomm Competitions aims to raise general awareness of opportunities in the infocomm field.
- To bridge the digital divide and create an integrated society in Singapore where infocomm awareness is pervasive and access is available for all, technology will be used to help the needy, elderly and differently abled to enrich their quality of life.

A National Infocomm Competency Framework (NICF) has been set as a human resource planning tool. Based on standards agreed by industry, it seeks to both widen and deepen the capabilities of professionals and serve as a comprehensive guide for training and certification for the full range of infocomm jobs. The framework allows professionals to assess their own skills

against established standards and to plan their career paths. It helps employers with their staff development programs. The framework also seeks to help training providers, with the design of training and certification programs, and ensure greater quality assurance in training and assessment (IDA 2008q).

A Call-For-Collaboration has been issued for the FutureSchools@Singapore project to transform the educational experience through infocomm. Five 'future' schools have been selected, and industry has been invited to participate in an open exchange to design and deploy solutions, products, and services. New forms of content like videos and interactive textbooks, as well as game-based learning and augmented reality learning environment with multi-user interaction, will be used to suit different learning styles.

The work in FutureSchools will be tapped to further develop Games for Learning and Learning Trails, as well as a Learning Digital Exchange where teachers and students can access educational content provided by educational institutions and commercial content providers. The content would be linked to other public resources from libraries and other archives. A technology development plan will provide a guide for schools in their innovations (IDA 2008r).

BackPack.NET provides a platform for interaction and sharing of experiences and ideas among educationists. The system gives access to a range of teaching and learning resources, and an opportunity to network within community and discussion forums. The objective is to bring together researchers, industry developers and schools to create new innovations for learning. The system enables the incubation of emerging technologies in education, an infrastructure for solution development, and collaboration between industry partners. It covers a range of pilot trials to experiment with and evaluate the use of new technologies, such as digital inking devices and specific educational applications through tools such as the tablet PC. Part of the program is the Classroom of the Future, which facilitates the visualization and showcasing of how technology can be incorporated into day-to-day learning in the future. In short, BackPack.NET enables R&D in education technology and nurtures a developers' community for technology incubation and development (BackPack.NET 2008).

OPEN SOURCE/OPEN CONTENT INITIATIVES

Singapore adopts a technology-neutral and pro-competition approach. There is increasing awareness about the availability of different types of software, including open source software. Both open source and commercial software solutions are deployed

in industry and the government sector in a complementary manner. Software choices and selections are made by individual purchasers based on individual needs, merits and requirements, and the adoption of open source software among companies and government agencies is growing at a modest pace.

A new project championed by Red Hat called the Open Source Collaborative Innovation aims to increase the number of Linux-based business applications in Singapore, and to expand the pool of available expertise. This is part of the IDA's infocomm Local Industry Upgrading Programme (iLUP) that seeks to upgrade the skills of local companies with support from international firms. Red Hat is also working with local academic institutions to teach Linux skills. Collaborative efforts include a new training facility in conjunction with Singapore Polytechnic to offer Linux resources to IT professionals, an open source think-tank with the Institute of Technical Education, and a centre for the development of commercial open source applications with Temasek Polytechnic (Business Times 2008a).

There are advocates calling for government to take a more proactive role in the use of open source, but the government recognizes the need to maintain a level playing field for all, and to allow products and companies to compete based on merit. There are some who believe that organizations may be more reluctant to try open source software, as they are often sufficiently funded to be able to spend on proprietary software, and cost savings from open source software implementations are not always present (ZDNet Asia 2007b). However, it is also self-defeating for advocates to call for preferential treatment of open source products as this implies that such products are not able to compete with commercial alternatives on their own merit.

RESEARCH AND DEVELOPMENT

There were 951 organizations performing R&D in Singapore in 2005, up from 811 in 2004. Of these, 900 are from the private sector, nine are from higher education institutions, 26 are from government, and 16 are public research institutes. The total R&D expenditure was SGD 4,582.2 million in 2005, up 12.8 percent from SGD 4,061.9 million in 2004. Sixty-six percent of the total R&D expenditure comes from the private sector, and 56.7 percent of total expenditure was in the area of engineering and technology. The total number of patents owned in 2005 was 3,475, up from 2,570 in 2004. In 2005, 1,594 patents were applied for and 877 patents were awarded (SingStat 2008b).

The Singapore government will set aside SGD 1.4 billion over five years to fund the development of three R&D areas that are key to the country's economic future: biomedical sciences, environmental and water technologies, and interactive and digital media. The aim is to create 86,000 jobs in these areas with a value added of SGD 30 billion by 2015 (EnterpriseOne 2008).

CHALLENGES

War for Talent and Quality of Jobs

The infocomm sector in Singapore faces increased competition from multi-service Asian firms and low-cost talents. After 25 years of developing the infocomm sector, it is noteworthy that there are no world-class icons in terms of high-value technology firms or software companies in Singapore. The best and brightest students are being drawn to softer sectors such as banking, finance, business, and sales. While the Singapore government recognizes the war for talent and the need to attract and sustain talented personnel who can innovate to exploit infocomm, it remains to be seen whether human resource development programs will succeed in shifting the infocomm industry to a higher-value trajectory.

Privacy and Data Protection Framework

It has been more than five years since the Singapore government recommended the use of an industry Code of Practice to address concerns regarding privacy and data protection (IDA 2002). Although spam legislation has been put in place, proper control of data held by organizations remains industry self-regulated. The growing trend worldwide is for some form of legislative framework to be put in place to set boundaries relating to the use of such data, and to allow consumers the ability to verify the accuracy of the information and prevent abuse. Such a framework will complement the spam control framework, which also deals with handling sensitive personal information such as electronic mail addresses and mobile phone numbers that are collected by organizations. It would be timely for the Singapore government to revisit the establishment of a legal framework concerning privacy and data protection of private personal information in Singapore.

Governing Philosophy toward Innovation and Competition

At a regional forum for government officials in Asia, the former chairman of IDA articulated three principles that are essential for managing innovation in a country — the market must lead the government; governments cannot have favourites but must consider all objectively; and governments need to be circumspect about the extent of engagement in economic management. He believed that these key principles make companies more efficient and competitive in the global market. If the companies cannot compete overseas, there is a limit to which they can be supported by the state. He believed in the role of governments as referees, and added that they need to be completely technology-neutral,

and to refrain from trying to pick winners and losers. Governments need to both encourage foreign investment as well as develop local companies and talents. Drawing from Singapore's experience, he highlighted the positive effects of liberalization and competition, noting that foreign investment is attracted by the establishment of a robust legal regime, which also serves to provide a conductive environment for local firms to grow. Indeed, competition is essential for innovation. If there is no competition or threat of competition, there will be no innovation. This is a challenge that many governments today need to address.

NOTES

1. The over-the-air broadcast signals will be received by mobile phones and other portable devices directly (in a point-to-multipoint manner) rather than being transmitted via the cellular network (in a point-to-point manner, which limits the number of concurrent users).

2. See www.barcodeman.com/faq/2d.php for an illustration of the differences between 1D and 2D barcodes.

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.lk

Sri Lanka

Ruvan **Weerasinghe** and Chamindra **de Silva**

Total population	20,010,000 est.[a]
Literacy rate (disaggregate by gender)	Male = 92.3%; female = 89.1%[b]
GDP per capita (PPP in USD)	4,265 est.[c]
	4,000 est.[d]
	4,259 est.[e]
Computers per 100 inhabitants	8.2 households[f]
Fixed-line telephones per 100 inhabitants	15.5[g]
Mobile phone subscribers per 100 inhabitants	45.7[g]
Internet users per 100 inhabitants	3.65[h]
	4.0[i]
Domain names registered under .lk	7,000 est.
Broadband subscribers per 100 inhabitants	0.33[i]
Internet domestic bandwidth	NA
Internet international bandwidth	0.24 Mbps/10,000 population[j]

(Sources: [a]DCS 2007a; [b]DCS 2001; [c]IMF 2008; [d]CIA 2008a; [e]WB 2008a;
[f]DCS 2007b; [g]TRCSL 2008a; [h]CIA 2008b; [i]ITU 2008; [j]WEF 2008)

INTRODUCTION

Sri Lanka is number 99 out of 177 countries in the Human Development Index (UNDP 2008) and number 90 out of 157 countries in the Economic Freedom Index (The Heritage Foundation 2008). In South Asia, Sri Lanka is performing relatively well in terms of per capita GDP, life expectancy, literacy, economic freedom, and overall policy environment. In e-Government Readiness rankings (UN 2008), Sri Lanka is 101st of the 189 countries surveyed, but toward the top of the South Asian group. The country's Network Readiness Index (WEF 2008) is 79th among the 127 countries, while its e-Readiness Index (*The Economist* 2007a) is 60th among 70 countries.

These figures demonstrate the resilience of the economy and the people of Sri Lanka in the face of the unstable ethno-political situation that has had significant economic and human costs over the past three decades. This resilience would be quickly converted to prosperity were the situation in the country to improve. It is against this hopeful backdrop that the status of information and communication technology (ICT) in Sri Lanka is presented in the following sections.

TECHNOLOGY INFRASTRUCTURE

The telecommunications industry has grown continuously since its liberalization in the early 1990s and particularly since the introduction of Global System for Mobile communications (GSM) for mobile telephony. In 2007, 2.74 million fixed lines and almost 8 million mobile subscriptions put Sri Lanka's teledensity at 51.3 per 100 inhabitants (TRCSL 2008a). Fixed phone teledensity is 13.1 (35.2 in the Colombo district) while the overall mobile teledensity is 38.2.

The mobile telephony sector continues to be the most aggressive and innovative with the introduction of High-Speed Downlink Packet Access (HSDPA)-based third generation (3G) technology by the two main operators, Dialog Telkom and STL-Mobitel. With initial coverage in Colombo, this is now available in many of the main cities.[1] In fact, Sri Lanka's telecoms industry is known as the first to implement the 3G, 3.5G, and HSDPA network in South Asia.

Competition in broadband services provision was intro-duced in 2007. Asymmetric Digital Subscriber Line (ADSL) is now available in all cities, with more package options and with a reduced entry level monthly subscription of USD 10.[2] More broadband options using Worldwide Interoperability for Microwave Access (WiMAX) technology and with bandwidths of 2–10 Mbps are also available in several major cities.

Dialog Telkom launched a mobile television (TV) service on 3G, while Sri Lanka Telecom (SLT) has announced that it would launch Internet Protocol TV (IPTV) by the end of 2008.

Personal computer (PC) penetration has escalated since 2001 when a national census reported only 4 percent of households owning a computer, according to vendors.[3] The Information and Communication Technology Agency (ICTA) believes that its launching of the e-Sri Lanka low-cost PC in 2004 helped boost computer sales to a 15–19 percent increase year-on-year, despite the removal of the duty exemption for computers and peripherals in 2004.

SLT, the incumbent, has begun rolling out its national back-bone based on Multi-Protocol Label Switching (IP/MPLS) technology to future proof it for the advent of Next Generation Network (NGN) services and standards. The 1,500-kilometre

high-speed fibre backbone is organized into multiple regional rings. The Colombo Metro, Central, and Southern rings are already in place; the Northern, Eastern, and Uva rings are being laid out; and rings to cover other major cities are being expanded. The backbone reaches the last mile via ADSL and ADSL2/2+ connections ranging from 512 Kbps to 24 Mbps.

Dialog Telekom, which currently has a national fibre backbone supplemented by their WiMAX technology option for broadband to the door, claims a coverage of up to 80 percent of the country.

The National Backbone Network plan of the Telecommunications Regulatory Commission (TRC) could be realized if the two big players, SLT and Dialog Telekom, can be persuaded to complement each other's efforts.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The ICTA (www.icta.lk) was set up through an Act of Parliament in 2003 to implement the ambitious Sri Lanka National ICT Roadmap through the e-Sri Lanka program (discussed further under 'Key ICT Programs'). The ICTA's mission, which is closely linked but not identical to the implementation of the e-Sri Lanka program, has five main branches: building the information infrastructure, re-engineering government, private sector development, human resource development, and empowering citizens through ICT (e-Society).

The ICTA has provided a 'neutral ground' where key stakeholders can interact in a direct way to overcome suspicion of each others' motives. For example, in private sector development and ICT investment promotion, key industry players have come together to form an advisory committee that decides how a fund earmarked for this purpose, referred to as the ICT Capacity Building Fund (ICBP), is best spent. Key interventions by this informal consortium include:

- Providing grants or matching grants for ICT companies to gain ISO and CMMI — Capability Maturity Model Integration (SEI 2008) accreditation, train their employees in pre-identified areas of weakness, and expose senior management to best practices overseas;
- Initiating an annual awards event recognizing excellence in ICT leadership;
- Facilitating a matchmaking scheme to link local software companies with potential large customers overseas; and
- Providing research and innovation grants through competition.

Among the telecoms service providers, SLT is the largest and formerly the only operator of all types of services. Dialog Telekom is the largest mobile provider: since 2006 it has restructured and diversified into all types of services. Suntel is a wireless local loop (WLL) provider now concentrating on corporate services. Lanka Bell is the other WLL provider and it is currently planning a major expansion of services. LankaCom also owns its own submarine link.

In 2005 these companies protested an ICTA plan for a countrywide high-speed backbone to reach the 'un-profitable' rural areas. Subsequently however, they came up with their own solutions to regional connectivity that resulted in the TRC engaging the industry to form a public-private partnership for building a National Backbone Network (TRCSL 2008b).

The Licensed Internet Service Providers Association is an important player in the infrastructure optimization process since it houses the Sri Lanka Internet Exchange (LKIX).

The University of Colombo School of Computing (UCSC), University of Moratuwa (UoM), University of Peradeniya (UoP), Sri Lanka Institute of Information Technology (SLIIT), and Informatics Institute of Technology (IIT) provide ICT training at the Bachelor's and Master's level. The 'big three' — UCSC, UoM, and UoP — also engage in ICT research in collaboration with international and industry partners. All state universities and several other smaller private institutes, including the National Institute of Business Management (NIBM), Asia Pacific Institute for Information Technology (APIIT), and Australian College of Business and Technology (ACBT), also cater to the senior tiers of the skilled ICT workforce.

The industry organizations in the ICT field include the Software Exporters Association (SEA, www.islandsoftware.org) consisting of some 50 key software exporting companies aiming to promote Sri Lankan software. The older Sri Lanka Association for the Software Industry (SLASI, www.slasi.com) has over 50 member companies. The Sri Lanka Computer Vendors Association (SLCVA, www.slcva.lk) is composed of some 50 computer hardware and peripheral suppliers, while the Association of Computer Training Organizations (ACTOS, www.actos.lk) includes 30 key ICT training providers. The Sri Lanka ICT Association (SLICTA, www.slicta.lk) is an umbrella organization aiming to bring together these and other associations. The Computer Society of Sri Lanka (CSSL, www.cssl.lk) is an organization of IT professionals that promotes continuing education for members and organizes the annual National IT Conference.

The Infotel Society has held ICT trade exhibitions since the 1990s. It brings together representation from several key ICT associations formerly organized as the Federation of IT Industry in Sri Lanka (FITIS). Closely associated with this

exhibition is the International IT Conference (IITC) organized by Infotel and managed by the UCSC. More recently, the ITPro informal 'open' grouping of industry organizations has become an important portal (www.itpro.lk). Also, the leading IT and business process outsourcing (BPO) associations of Sri Lanka have decided to come together to make 'one voice heard in the indusry' through the formation of the Sri Lankan Association of Software and Services Companies (SLASSCOM, www. slascom.lk) modeled on India's NASSCOM.

Both the University Grants Commission (UGC) and the Ceylon Chamber of Commerce (CCC) have standing/sub committees on information technology that are the official channels through which tertiary education institutions and the non-IT industry coordinate efforts in their respective sectors and interface with other industry organizations and associations. The Sri Lanka Export Development Board has its own ICT Advisory Committee drawn from key organizations to help it coordinate efforts in promoting the ICT export market locally and overseas.

To create ICT communities, the president's office, the Ministry of Education, and the ICTA have collaborated on the launching of an eVillages[4] initiative in five communities. Building on the success of the Horizon Village (http://www. horizonlanka.org/) in Mahavilachchiya, the eVillages initiative uses ICT as a tool and enabler of socio-economic development, particularly by the youth in rural communities.

Citizen journalists or bloggers are rapidly becoming an influential community in Sri Lanka. The award-winning Ground-views blogsite (www.groundsview.org) has matured to publish excellent journalism and it is beginning to cover a wide range of issues in the country and the region. Its sister site Vikalpa (www.vikalpa.org) aims to provide a similar platform for Sinhala and Tamil citizen journalism. Kottu (www.kottu.org) remains a key Sri Lankan blog aggregator that also has some local language blogs in their new listing. The Sinhala Bloggers Union (www.sinhalabloggers.com) and the Sinhala Blog Syndicate (www.sinhalablogs.com) aim to promote local language blogging. These and other efforts bode well for a stronger civil society.

Another community that could contribute significantly to the development of the Sri Lankan ICT vision is the Free and Open Source Software (FOSS) community consisting of members of the Lanka Linux User Group (LKLUG, www.lug.lk) and members of the Open Source research and development (R&D) non-profit Lanka Software Foundation (LSF, www. opensource.lk). These two groups, together with the industry bodies, advocate FOSS under the umbrella community FOSS. lk (www.foss.lk).

ICT AND ICT-RELATED INDUSTRIES

Sri Lanka's GDP for 2007 was USD 31.2 billion, representing a 6.1 percent growth year on year and putting the country at number 78 out of the 183 countries listed (Wikipedia 2008). Exports stood at USD 7.9 billion, and imports accounted for USD 10.4 billion. Services dominated with 56.5 percent of GDP, followed by agriculture, forestry, and fishing (16.5 percent); manufacturing (13.9 percent); construction (9 percent); and mining (2.2 percent) (The Economist 2007b). The principal exports were textile/garments, tea, diamond/jewelry, and software.

Revenues from software export, BPO, and IT-enabled services (ITES) crossed USD 275 million in 2006, exceeding the previous year's income by over 30 percent (ICTA 2007a) and making this one of the most promising industries for wealth creation. In fact, Sri Lanka was recently ranked 29th among the top 50 outsourcing destinations in the Global Services Location Index. This index takes into account 41 measures in the three major categories of cost, people skills, and availability (Kearney 2008). In another study (Tholons 2007), Colombo was ranked 7th among top 50 emerging outsourcing cities. In particular Colombo was recognized as a Centre of Excellence for Financial and Accounting Outsourcing due to its having the largest pool of Chartered Institute of Management Accountants (CIMA) trained accountants outside the United Kingdom (UK).

According to the Software Exporters Association, there are over 175 software development companies providing products and services for both the domestic and export markets. IT firms in Sri Lanka that are serving Fortune 500 clients mainly in North America and Europe adhere to rigorous industry standards and regulations such as CMMI, ISO 27001, Basel II, SOX, and Data Protection Acts. Industry associations have identified the following niche sectors based on existing strengths: banking, financial and insurance applications, mobile application development, software testing, and Open Source R&D (FOSS 2007). One of the largest IT firms founded in Sri Lanka was ranked number one by the Brown-Wilson Group's annual 'Black Book' survey of Top Outsourcing Vendors in the Wealth Management Industry (Business Wire 2007).

Investments in the ITES and BPO sector in the last five years amounted to USD 44 million. To attract additional investments, the government is offering a tax holiday of 3–12 years depending on the size of a company. Industry associations are aiming for a BPO industry revenue of USD 2 billion and employment of over 100,000 people by 2012. However, the business environment needs to be improved as a World Bank study ranked Sri Lanka at a mediocre 101 of 178 countries in 2007 with regard to establishing new business, labour laws,

taxes, infrastructure, investment protection, and licences (World Bank 2008b).

Current demand for IT professionals is constrained mainly by lack of youth and graduates with good communication skills. This problem is partly due to the low capacity of the education system in Sri Lanka: many students are eligible for higher education but only a few can be taken into the system, especially for ICT-based programs. On the other side of the coin, roles and skill levels in the industry have matured and are now at par with those in India.

Over 20 percent of graduates are unemployed, signifying a mismatch between industry demands and education output. Thus, one of the main thrusts of the ICTA and industry associations is capacity development. In addition, the government's Board of Investment is establishing a partnership with firms, such as India's Mahindra and Mahindra, to establish IT parks.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Arguably the most important ongoing ICT initiative in the country is the e-Sri Lanka program being implemented through the ICTA. The e-Sri Lanka initiative is the umbrella vision of the government of Sri Lanka to use ICT to develop the economy, reduce poverty, and improve the people's quality of life. This vision is being realized through a five-program strategy: building the implementation capacity, building information infrastructure, and an enabling environment, developing ICT human resources, modernizing government and delivering citizen services, and leveraging ICT for economic and social development through public-private partnerships.

Major funding comes from the World Bank and a government-wide network funded by the Korean government. Although the initial investment period ends in 2009, only about 35 percent of the initial grants has been disbursed to date, and it is likely that the investment period will be extended. There are also moves to ensure sustainability by transferring ownership of initiatives to the key institutions involved in e-Sri Lanka projects.

Two key connectivity projects have been tendered out by the ICTA. One is for connecting 1,000[5] Nenasala Telecentres (www.nanasala.lk/) scattered around the country with a 128 Kbps link. The other is the more critical Lanka Government Network (LGN) connecting some 650[6] divisional secretariats and key state institutions distributed throughout the country. The operators who won the tenders are reaching beyond their normal areas of operation into less economical areas using newer technologies such as Code Division Multiple Access (CDMA), Wireless Fidelity (WiFi), and Worldwide Interoperability for Microwave Access (WiMAX).

Re-engineering government is arguably the most ambitious of the ICTA's programs. The primary areas for improvement are: introduction of modern technology, upgrading IT skills, setting up local and intra networks, initiating ICT leadership within organizations, and providing a 'single window' for government services to the citizenry. Key local government agencies now have the necessary ICT equipment and are connected through the LGN network. Key human resource development strategies have targeted basic awareness training for 10,000 government employees and certification level training for up to 4,000 of them. In addition, around 1,000 are expected to be trained in technical skills such as system and network operations and basic maintenance. A cadre of chief information officers (CIOs) in state organizations and divisional secretariats are to be the 'champions of change'. The ICTA has been actively working with the independent Administrative Reforms Committee (ARC) that is now a permanent National Administrative Reforms Council (NARC).

A 'single window' concept for providing government information to the public was launched in August 2006 with a short-code number (1919) which provides a gateway to information about some 250 services provided by 20 agencies.[7] The main government Web portal remains at www.gov.lk. But there are plans to amalgamate the mostly informational services provided through this portal into the ambitious LankaGate portal that will provide a one-stop gateway to transactional level services for the citizenry. Twenty-five key government computerization projects have been facilitated by the ICTA to simplify cumbersome processes and eliminate bureaucratic delays to transform organizations into the 'Integrated' or 'Connected' stage of e-government. An example is the drive-through service in Colombo for issuing a motor vehicle revenue licence.

An interesting program area is the e-Society development initiative. Aside from the Nenasala training program for telecentre operators, there is a competitive fund to stimulate innovative citizen services. Small grants have been used to experiment on using the FM spectrum to facilitate disaster preparedness, setting up a secondary school curriculum learning management system,[8] and deploying a Text-2-Braille system in the Colombo Deaf and Blind School. These and other smaller grants are expected to feed into services deployed through the Nenasala Telecentres, with some interesting results beginning to emerge. Among them are a job portal which also facilitates transfers of government employees, a cottage BPO industry for providing Sinhala language translation services, and remote health services. In addition, the ICTA has recently used the open source GRails framework technology to rapidly build an agricultural price tracking solution to support an e-Society

grant application. In the next stage of this project, an SMS-based interface is expected to be provided for crop price monitoring.

The Government of Sri Lanka has declared 2009 the 'Year of English and IT', giving the ICT industry a boost by funding several initiatives designed to help empower the human resource base of the country, and harness its true potential to make Sri Lanka more competitive in the global IT-BPO industry.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Sri Lanka has been steadily ramping up its regulatory environment in support of trends toward globalization and outsourcing (Fernando 2007). Computer software and digital media are given protection under copyright law. In addition, 'Computer' and 'Computer Program' have been explicitly defined in the 2000 Amendment to the Code of Intellectual Property and the Intellectual Property Act No. 36 of 2003 (WIPO 2001). The recently enacted Computer Crimes Act No. 24 of 2007 further enhances the protection measures already available for software (ICTA 2007b). And with the most recent amendment to the Intellectual Property Law in Sri Lanka, protected rights now include copyright, patents, trademarks, service marks, industrial designs, certification marks, unfair competition, undisclosed information and layout designs of integrated circuits (Sirisena and Kahatapitiya 2006). Patents remain valid for 20 years, industrial designs for five years and registered marks for 10 years from the date of grant.

Disclosure and acquisition of information without the consent of the rightful owner would constitute an act of unfair competition and there is statutory protection for Non-Disclosure Agreements (NDAs) that many firms now utilize to protect their intellectual property rights (IPR) and those of their clients. IP infringement is a punishable offense in Sri Lanka and the country is a signatory to several international conventions and treaties on intellectual property (BOI 2008). The National Intellectual Property Office (NIPO, www.nipo.lk) administers the intellectual property system and the director general of intellectual property has been empowered to conduct dispute resolution.

The Computer Crimes Act also criminalizes attempts at unauthorized access, modification, deletion, interception or denial of service to a computer, computer program, data or information. It contains a provision dealing with unauthorized use of computers regardless of whether the offender had authority to access the computer concerned (Fernando 2006a; LBO 2007).

The Electronic Transactions Act of 2006 was enacted to provide a legal framework for and to facilitate the expansion of electronic transactions and contracts (Fernando 2005, 2006b). Included in the law are modalities for the use of electronic records and electronic signatures in government institutions and statutory bodies. It also stipulates procedures for the appointment and accreditation of a certification authority. Most of the provisions are based on the United Nations Commission on International Trade Law (UNCITRAL) Model Law on e-Commerce (1996) and the Model Law on e-Signatures (2001).

The main gap that remains is a data privacy law that the government needs to enact to build greater confidence among the country's trading partners, especially in the European Union (LBO 2008b). In enforcement, the government has decided that investigation capability in computer crime should be strengthened, and a Computer Crimes Unit with computer forensic skills should be established. The ICTA has started a program to develop capacity in computer crime investigation at the Police Department. Additionally, a National Computer Emergency Response Team (SL-CERT, www.slcert.gov.lk) has been established by the government with subject matter experts in Information Security.

In telecoms regulation, the Telecommunication Regulatory Commission of Sri Lanka (TRCSL, www.trc.gov.lk) issues licences to operate basic telecom service, import telecoms apparatus, and manage the radio frequency spectrum. It regulates the telecom industry and resolves disputes on matters related to interconnection.

DIGITAL CONTENT

All government websites are required to be multilingual (in Sinhala, Tamil, and English) and to use Unicode fonts. A local languages portal containing software required for this purpose is available at www.locallanguages.lk/, with the Sinhala version at www.siyabas.lk/, and the Tamil version at www.emathumozhihal. lk/. These sites also have links to local language websites. The Google country search interface now allows searches of local language websites encoded in Unicode, while an older but useful search service, www.sinhalasearch.com/, is able to decode most proprietary Sinhala encodings on-the-fly and render search results (and the relevant page if needed) in Unicode. Another useful webpage translation tool released by the UCSC is available as a Firefox plug-in with the twin objectives of making English Web content understandable while at the same time helping users expand their English vocabulary.

There are also Sinhala Unicode Communities promoting the use of Unicode for Sinhala and freelance bloggers organizing themselves into community journalism forums. Most Sinhala and Tamil newspapers have online versions, with several switching to Unicode as the standard encoding.

A large corpus of Sinhala text in various genres has been compiled by the Language Technology Research Laboratory at the UCSC.[10] There are projects aiming to generate new content or to translate existing English content. A parallel activity has been the localizing of software applications.

A learning management system (LMS) called Shilpa Sayura (www.shilpasayura.org) enables the creation of learning materials in Sinhala for high school subjects. It received awards from the Global Knowledge Partnership in Kuala Lampur, Malaysia in 2007 and the Stockholm Challenge in Education in Stockholm, Sweden in 2008.

ONLINE SERVICES

Government Services

Currently, almost all government institutions have a presence on the Web. Although most of these websites merely provide information, some government websites provide services that at least cut down the number of visits a person has to make to the government office in Colombo by giving clear instructions and making available the necessary forms for download. The 1919 Government Information Centre (GIC, gic.gov.lk) provides a particularly useful service over the phone in the three main languages used in Sri Lanka. More recently, the Registries of Births, Deaths, and Marriages have been computerized and all of the Colombo District-based Grama Sevaka (GS, the lowest government administrative level, originally based on the village headman) divisions have been networked, thereby allowing individuals to transact with any nearby GS Office without having to go to their own 'home' office (see 'e-Sri Lanka Procurement').

e-Commerce

e-Commerce sites continue to populate the local Internet, with some providing transactional services. Smaller retailers, particularly those targeting Sri Lankans who want to purchase goods and services for their relations in Sri Lanka, are increasing in number. Business portals such as www. srilankabusiness.org provide allied services and links to online businesses.

In a new and exciting development, the Horizon Lanka Foundation has started a new BPO thrust with the incubation of one of the first rural BPO companies.[11] It provides various data services, including entry, verification and scanning, and offers Web and graphics design outsourcing. It recently signed up with a leading Sri Lankan conglomerate, John Keels Holdings, to provide such services to and through them.

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e-Sri Lanka Procurement

The main issue with the traditional 'waterfall' based procurement process is that the end-user (i.e. the government unit or organization) is unable to envision the type of ICT solution needed while the solution provider has very little understanding of how the government works. A new approach utilizes agile development methodologies and incremental refinement of requirements to produce an evolving solution where the end-user's needs are gradually fine-tuned as they become more aware of how to effectively articulate their ICT and business process re-engineering needs. Additionally, to remove vendor lock-in and develop a transparent solution, the high-level architecture is defined by the ICT agency and aspects of the business requirement are broken into modules which are given separately to different vendors to develop independently and incrementally.

In this alternative approach, an initial high-level system study is used to define an overall architectural view. The objective is to build/assemble the solution by formulating more than one project based on a logical module/service/component breakup. The feasibility of such a 'composed' solution is first validated with a thin-slice prototype implementation by leveraging FOSS packages and frameworks. The ICTA then partners with software services providers to implement each module/service/component using identified FOSS-based technologies to prevent vendor lock-in, facilitate rapid solution development, and reduce the initial deployment costs while enabling the Government of Sri Lanka (GOSL) to retain ownership of the IP and source code. In this way, the GOSL derives the ability to improve, customize and deploy the solution anywhere in the country, at minimal additional cost. Long-term solution support and maintenance are also procured from a solution services provider, who in turn is typically expected to obtain an appropriate support licence/agreement from the relevant FOSS product vendor.

Currently, the Sri Lanka country portal LankaGate, one of the largest eSri Lanka projects, is being implemented using this novel approach. The upcoming welfare project eSamurdhi is also expected to employ this procurement methodology.

ICT EDUCATION AND CAPACITY-BUILDING PROGRAMS

One of the components of the Secondary Education Modernization Project (SEMP, www.moe.gov.lk/semp/) of the Ministry of Education is employing IT as a tool to facilitate learning. Aside from basic computer skills, teachers have been trained to use Computer Aided Learning (CAL) to develop instructional materials. Computer laboratories have been set up in over 1,000 schools and together they form a network of schools (SchoolNet, www.schoolnet.lk). In addition, 90 Computer Resource Centres (CRCs) established in the early 1990s have been enhanced to serve schools in their regions through ICT and CAL training programs. Several national Colleges of Education are training ICT teachers. There is a plan to have a College of Education dedicated to training ICT and CAL teachers for the schools.

In the tertiary education sector, a World Bank-funded project to improve the quality and relevance of undergraduate education (IRQUE, www.irque.lk) is underway in all state and the larger private tertiary educational institutions. Organizations participating in this project are required to upgrade their ICT infrastructure, facilities, and services. In addition, all Arts and Commerce undergraduates receive basic ICT training.

Furthermore, the inter-university Lanka Education and Research Network (LEARN, www.learn.ac.lk) connecting all state universities and several research institutes has been enhanced from the previous 2 Mbps backbone to 10 Mbps with capability to scale to 100 Mbps. LEARN's Internet connectivity has also been significantly enhanced from 7 Mbps to 45 Mbps.

The Distance Education Modernization Project (DEMP, www.depp.lk/demp.php) funded by the Asian Development Bank aims to facilitate the scaling up of higher education through the development and support of online distance education programs. It has an infrastructure component closely linked with the regional centre modernization of the Open University, a networking component to link all online education providers, and a distance education capacity and quality improvement component.

Two active online learning communities are the e-BIT (www.bit.lk) for undergraduate students and the award-winning Shilpa Sayura (www.shilpasayura.org) program for high school students in rural Sri Lanka. Both have received international recognition as innovations in the use of ICTs for education.

Also, at the secondary education level, the Ministry of Education has completed a pilot project to convert three of the most used text books in Year 6 and Year 10 into eText books distributed on CD. Eighteen of the most widely needed texts will be converted to eBook format in 2008 (see 'eBIT:

Scaling up Tertiary Education in ICT through Public-Private Partnership').

The first major assessment of IT literacy in Sri Lanka was made through the national census of 2001. The results, which were released in 2003–2004, showed that the average IT literacy in the country was a mere 9.7 percent. IT literacy is reported to have grown to 16.1 percent in 2006/2007 (DCS 2007b), due to various ICT awareness and literacy projects. A National IT Quiz organized by the UCSC in 2006–2007 has enhanced awareness of IT careers among high school students, their teachers and parents. An ICTA-sponsored Careers Fair (NICS '07) also helped improve awareness of IT among students planning to pursue tertiary education. In addition, ICTA's e-Citizen project aims to reach 100,000 people nationwide through a specially prepared curriculum.

The Ministry of Education introduced a General IT course for all Advanced Level (Grades 12 and 13) high school students in 2004. From 2006, an IT subject was introduced at the Ordinary Level (Grades 10 and 11). There are plans to introduce a Grade 6–9 IT curriculum to coincide with the development of a new cadre for the IT teacher service to be established soon.

All 15 state universities and several private institutes with a franchise on overseas degrees offer computer science, computer engineering, IT/ICT degrees, as well as degrees in which IT is a component or a minor. According to a recent survey,[12] the country needs 5,755 new IT graduates in 2008. However, existing programs are known to produce slightly less than 50 percent of the number of IT graduates needed each year. Thus, the aim of the UCSC's e-BIT program and the DEMP project is to increase the total online undergraduate population to 40,000.

Several universities, most notably the UCSC, UoM, UoP, and SLIIT, also offer heavily subscribed Master's level IT and computer science programs with various specializations. In addition, the UCSC and UoM offer research degrees leading to an MPhil and PhD, often in collaboration with international universities.

OPEN SOURCE/OPEN CONTENT INITIATIVES

The FOSS movement in Sri Lanka started with the Lanka Linux User Group (www.lug.lk) established in 1998 with 40 members and five advisors. It has since grown to a diverse community of over 500 technical users of Linux and related FOSS applications across the country. Linux User Groups also exist in universities to promote mutual learning and adoption of FOSS. In 2001 the Lanka Software Foundation (www.opensource.lk) was established by a Sri Lankan IBM researcher as an open source

eBIT: Scaling up Tertiary Education in ICT through Public–Private Partnership

Sri Lanka has one of the lowest university enrolment rates in the world, with only about 2 percent of the age cohort having access to the very few places available for undergraduate study. To scale up ICT education, which it recognized as important for meeting the chronic shortage of IT workers, the UCSC worked within the very restrictive state higher education system and without dependence on state funding.

Through a series of grants from the Japan International Cooperation Agency (JICA) and the Swedish International Development Cooperation Agency (SIDA), the UCSC set up an eLearning Centre which pioneered tertiary level e-learning both for in-campus programs and its flagship Bachelor of Information Technology (BIT) program. The three-year BIT program, first launched in 2000 when Internet access was limited, initially only provided an informational website with instructions, curricula, question papers with answers and examination results. In its first three-year curriculum cycle, it enlisted the support of several leading private ICT training institutes to provide tuition in the regions in what has become a landmark public-private partnership (PPP).

Students can temporarily or permanently exit with a Diploma after completing their first year or with a Higher Diploma after completing their second year. Thus, this innovative program has provided a flexible and scalable solution to expanding IT education at the tertiary level. In its second revision in 2003 the BIT introduced an online component in addition to its website (http://www.bit.lk/). The new e-BIT is a full-fledged e-learning platform providing interactive online learning content, quizzes and assignments, and attracting some 1,500 enrolees each academic year. More than 5,000 of its 15,000 student population are active during any year, with many opting to do the degree in stages. In 2007, the UCSC began conducting its own e-testing service for the BIT program through its e-testing centre in Colombo. This is expected to be decentralized during the coming year, in partnership with the DEMP project's 26 Access Centres affiliated with the Open University of Sri Lanka, to truly bring the benefits of higher education in IT to the community.

The eBIT project was recently recognized by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and it received special mention in the Innovative Use of ICT in Education Award in 2008.

R&D non-profit organization. These two key organizations, with the support of the Sri Lankan ICT industry and significant investments from well-known global organizations such as Google, IBM, the Swedish International Development Cooperation Agency (SIDA), the National Science Foundation (US), Intel, Redhat and MySQL, have fuelled the adoption of FOSS and FOSS R&D in Sri Lanka.

The landmark advocacy event was the National FOSS Week in 2005 which attracted over 1,000 participants (FOSS 2006). In 2006 the main FOSS event was ApacheCon Asia (apachecon.com/2006/Asia/), the first time an Apache Conference (ApacheCon) was held outside North America or Europe. In addition, numerous events are organized throughout the year by the FOSS community to take open source and open content to the general public.

There is a special focus on ICT in rural schools. However, the Ministry of Education has not adopted open source in its IT curriculum, which is still based on proprietary technologies. In contrast, universities are benefiting from an increased demand for open source courses which they offer to their students and as short courses for the IT industry.

The ICTA, in partnership with some of the main computer software vendors, has launched the e-Sri Lanka PC (www.icta.

lk/insidepages/programmes/e-Sri_Lanka_PC.asp) which is pre-loaded with Linux and open source software as a low-cost alternative to desktop computing. However, for better adoption of open source software, there should be better training programs and a support network for users.

Additionally, the newly established OLPC Lanka Foundation, in partnership with the Ministry of Education and with support from the World Bank, is promoting the One Laptop per Child (OLPC) project to help bridge the digital divide (Bandula 2008).

Open source development has been identified as a growth sector for the country and there are now numerous companies supporting open source products and based on open source innovation and services.

In open content, the most significant initiative is the MIT Open Courseware which in Sri Lanka is hosted on the academic LEARN network (ocw.learn.ac.lk). Although Sri Lanka has a relatively high literacy rate, most content is in Sinhala, the dominant language. A large part of global open content repositories, such as Wikipedia, is not available in Sinhala and Tamil. To mitigate this, a dynamic translation tool called EnSiTip has been developed by the UCSC and is available as a plug-in to the open source Web browser Firefox (LBO 2006).

The importance of 'funding a broad program to foster Open Source software development in Sri Lanka' is stated in the e-Sri Lanka program Project Appraisal Document. Popularizing the use of FOSS applications and providing training to transfer expertise to the grassroots are expected to help build a strong workforce who would be conversant not only in the use of FOSS technology, but also in the design of new technology to suit the country's needs.

ICT AND ICTD RESEARCH AND DEVELOPMENT

The UCSC has research groups working in local language technologies, distributed computing, wireless and ad hoc sensor networks, e-learning, geographical information systems, and computer visualization. There are also research efforts in information security, strategic business systems, and disaster management. Several have international collaboration and are funded by external agencies.

In localization and language processing, much has been done in the standardizing process as well as ensuring the proper functioning of Sinhala and Tamil on computers while at the same time developing software for optical character recognition and text-to-speech chiefly for Sinhala. In addition, some key resources such as a 10m word text corpus, several lexical and morphological data have been collected for Sinhala. Research is also underway in handwriting and speech recognition for Sinhala. The software developed is also being tested on Sri Lankan Tamil to adopt or adapt them for use in Tamil language work.

The Wireless ad hoc Sensor Network Lab (WASN) at the UCSC was established in February 2006 with assistance from the Swedish Program for ICT in Developing Regions (SPIDER) and the Ericsson Microwave Systems AB. Currently, the centre's main focus is developing a sensor network called BusNet to be deployed over a public transport system. BusNet sensors mounted on public transport buses will monitor environmental pollution and road surface conditions. The collected data is to be 'transported' to a central collection point over the public transport network. This is pioneering work and some US and European universities have included published papers on BusNet in the required reading lists of their sensor network courses.

The University of Moratuwa has been involved in research with several private companies such as Dialog, Microimage and Zone 24×7 through its innovative University Industry Cell (Unic) to develop several technologies for communication and disaster alert.

Sri Lanka has also built a reputation for R&D in FOSS. Sri Lankan open source software developers have made significant contributions to organizations such as Apache where they (contributors from Sri Lanka) represent over 5 percent of the organization's global strength. There are several leading global open source R&D projects led by Sri Lankans in Web services, disaster management, Linux graphical interface, and networking applications. One of these is Sahana (http://www.sahana. lk/), developed to help manage the scale of the Asian Tsunami in December 2004 and deployed by the government's Centre of National Operations (CNO), which included the Consortium of Humanitarian Agencies (CHA). SIDA funded a second phase through the LSF to generalize the application for global use and to help in any large scale disaster.

Sahana is now globally recognized, with deployments in many other disaster situations, including the Asian Quake (Pakistan) in 2005, the Mudslide Disaster (Philippines) in 2006, the Yogyarkata Earthquake in 2006 (Indonesia), the Bangladesh Floods in 2007, and the Peru Earthquake in 2007. Sahana has won awards by Redhat and by Software 2006 (USA) and it has been featured in a BBC documentary called 'Code Breakers'. It was a finalist in the Stockholm Challenge in 2007, and it received the June 2007 Sourceforge 'Project of the Month' title. It has also had the active support of the IBM crisis response team. The Sahana community now consists of more than 200 disaster management experts, emergency management practitioners, humanitarian consultants, non-government organizations (NGOs), academics, and FOSS developers from around the world but mainly from Sri Lanka, Australia, New Zealand, Thailand, the UK, and the US.

Another good indicator of Sri Lanka's strength in R&D is the Google Summer of Code, where students are sponsored by Google to contribute to FOSS projects worldwide. Sri Lanka consistently ranks in the top 10 countries (GOOGLE 2008a). In 2008, the biggest group of students selected from a single university came from the UoM in Sri Lanka (GOOGLE 2008b).

CHALLENGES AND OPPORTUNITIES

A major challenge to Sri Lanka's continued development is the long drawn out civil war. This prevents the nation and its citizens from taking full advantage of the many opportunities that lie at its doorstep. An end to the war will mean an end to hesitation by investors, a reversal of the brain drain, and the discontinuance of propaganda that dilutes the potential and talents of the Sri Lankan people.

Sri Lanka's size compared to that of major players in the BPO and ITES sectors, such as India and China, prevents it from competing in areas that require a lot of human resources. Instead, it needs to pursue its own unique strategy for moving up the value chain by building on its strengths in niche areas. For instance, Sri Lanka is well positioned to provide globalized solutions to the emerging consumer societies of India and China. It can capitalize on its strengths in various professional service sectors such as accountancy, finance, healthcare and legal advice, which are at par with Western standards. In FOSS R&D, Sri Lanka has established itself as a major player globally. Moreover, the relatively high human development index and quality of life and the many award-winning projects in various sectors in academia and industry are a good indication of a culture of innovation that may be leveraged further.

Sri Lanka is also strategically placed as a neutral non-aligned hub for Asia. Its relatively high economic freedom index in Asia, its membership in the South Asian Association for Regional Co-operation (SAARC), and its strong ties to many other strategic nations in Asia (from Japan and China in the east, to Pakistan and Iran in the west) position it well to mediate and add value to economic relationships between these regions and nations.

NOTES

1. Some 90 cities are listed in http://www.dialog.lk/en/mobile/technology/3g/coverage_list.html
2. This is for a 512 Kbps link with monthly cap of 100 Mb. The unlimited subscription remains at USD 25.
3. However, these vendors are unable to give good estimates of either the total numbers or their regional distribution.
4. Information on the eVillages initiative is available at http://evillage.wordpress.com/
5. To date, nearly 500 Nenasala Telecentres are operational.
6. Around 325 of these sites have already been connected.
7. For more details, see the Government Information Service (GIC) website at http://www.gic.gov.lk
8. This goes beyond the 'transactional' stage to a point where all internal processes of an agency are also integrated to citizen, business and government services. (See, for instance, the 2008 UN e-Government Survey for a fuller description.)
9. Named 'Shilpa Sayura', this effort won awards at the GKP Summit of 2007 and the 2008 Stockholm Challenge.
10. Information on this 10m word corpus and other language technology tools and resources is available at http://www.ucsc.cmb.ac.lk/ltrl/
11. This first company is called OnTime Technologies and can be accessed at http://www.ontimetechnologies.net/
12. The ICT Workforce Survey may be downloaded from http://www.itpro.lk/?q=node/100

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Taiwan

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Total population	22,934,997 (as of October 2007)ᵃ
GDP per capita	USD 16,768 (NTD to USD: 32.167) (2007)ᵇ
Computer household penetration	79.4 (2007)ᶜ
Fixed-line telephones per 100 inhabitants	60% (2007)ᵈ
Mobile phone subscribers per 100 inhabitants	112% (as of December 2007)ᵈ
Internet users per 100 inhabitants	64.4% (December 2007)ᶜ
Domain names registered under .tw	4.32 million (as of July 2006)ᶠ
Broadband household subscribers	68.7% (2007)ᶜ
Internet international bandwidth	186,443.174 Mbps (as of February 2008)ᵍ

(Sources: ᵃMinistry of the Interior 2007; ᵇMinistry of Economic Affairs 2007; ᶜFIND 2008; ᵈNational Communications Commission 2007; ᵉTaiwan Net-work Information Center 2008; ᶠInternet Systems Consortium

OVERVIEW

The Government of Taiwan has launched three major national information and communication technology (ICT) programs since 2002 — e-Taiwan (2002), m-Taiwan (2005), and u-Taiwan (2007). ICT development in the country has been on track, except for a recent setback caused by political differences. In February 2006, a new government agency, the National Communications Commission, was established to regulate both the telecommunications and broadcasting sectors. However, since more NCC commissioners were nominated by opposition parties, the Democratic Progressive Party (DPP)-led Executive Yuan did not show much support for the National Communications Commission's plans and policies. The lack of communication between the Executive Yuan, which is the highest administrative organ of the state, and the National Communications Commission resulted in failure to implement some ICT policies, and the industry has complained about inconsistent policies among government agencies. However, the situation is expected to improve soon with the legislative and presidential elections held in January and March 2008, respectively. The opposition party Kuomintang (KMT) and its candidate for president Ma Ying-jeou, both won the elections.

Another recent development that is likely to have a beneficial impact on the continued advance of the ICT industry in Taiwan is the improvement in relations with China. In April 2008 Vice President Vincent Hsiao visited China and had a dialogue with Chinese President Hu Jintao. Moreover, President-elect Ma Ying-jeou has promised to remove the cap (usually 40 percent of a company's net value) on investment in China after his inauguration. Ma said this would help Taiwanese businesses compete

with multinationals in China and encourage businesses to keep their roots in Taiwan (Mo 2008).

In sum, it is too early to say that the prospects for Taiwan's economy in the coming years will be good, but the new government has at least committed to make the ICT industry more competitive than ever before.

TECHNOLOGY INFRASTRUCTURE

Fibre-to-the-home high speed Internet is replacing the traditional copper wire network in Taiwan. Newly built apartment buildings are being wired with Chunghwa Telecom's (CHT's) fibre optic networks, resulting in upload/download speeds of 10 Mbits per second, 50 Mbits per second, and 100 Mbits per second. Most households now have ADSL or cable modem for faster data transfers or video-on-demand entertainment. FIND (2007) notes that 68.7 percent of households surveyed have broadband access.

Taiwan has been praised internationally as the 'Republic of Computers' for its low-cost computer and peripherals production. However, the government is benchmarking Taiwan's ICT performance against South Korea's world-class streamlined broadband Internet infrastructure. Thus, the local Internet broadband market is being promoted, with local Internet users being given a wide variety of broadband services, including Asymmetric Digital Subscriber Line (ADSL), cable modem, leased line, Public Wireless Local Area Network (PWLAN), third generation (3G) phone, and 3G Data Card. The result is that the number of broadband subscribers reached over 6.09 million in early 2008 (*Intelligent Times* 2008).

To remain competitive with the most technologically advanced countries in the Asia Pacific, Taiwan has been keen to adopt the most recent Internet developments. For example, Taiwan's academic networks (consisting of universities and research institutes) and first-tier Internet Service Providers (ISPs) have pioneered in upgrading to Internet Protocol version 6 (IPv6) as the solution to the exhaustion of Internet Protocol version 4 (IPv4) and as a way of ensuring next generation Internet services development (Taiwan Network Information Center n.d.).

Taiwanese citizens are generally well-connected island-wide and the urban cities are considered as test beds of streamlined new wireless technologies. The capital city Taipei is a wireless 'Cyber City' — one of the first such cities in the world — supported with the broadband Wireless Local Area Network (WLAN) infrastructure. With the support of the new government, Taipei will team up with Intel to upgrade to Worldwide Interoperability for Microwave Access (WiMAX) infrastructure.

The Taiwanese are extremely enthusiastic about mobile phones. Most young subscribers have more than one mobile phone number, resulting in over 25 million mobile phone numbers issued by early 2008 and 112 mobile phone subscribers for every 100 inhabitants in early 2008 (National Communications Commission).

In contrast, Taiwan's digital television (TV) broadcasting services are not well accepted by the local population. Although audiences can now have 15 digital terrestrial TV channels, most broadcast programs remain unattractive digitized versions of earlier TV videos, and the number of digital cable TV subscribers remains low. With the sluggish development of digital TV broadcasting, most Taiwanese are unimpressed by the government-supported projection of a new digital TV broadcasting era in Taiwan by 2010. On the plus side, broadcasters are maintaining multiculturalism with daily drama programs broadcast in local dialects and two government-funded TV channels for indigenous people and the Taiwanese Hakka-speaking group.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The National Information and Communications Initiative Committee (NICI) is the foremost government body responsible for ICT policies. Established in April 2001, NICI combines three ICT-related task forces under the Executive Yuan and is responsible for accelerating the development of the IT industry, e-commerce and related businesses; improving the efficiency of government services; promoting Internet usage and related applications; and enhancing the competitiveness of the IT industry.

Two other government agencies are involved with the development of the ICT industry. The Council for Economic Planning and Development (CEPD) is a ministerial-level agency that is responsible for drafting plans for national economic development, evaluating development projects submitted to the Executive Yuan, coordinating economic policymaking activities, monitoring the implementation of development projects, and implementing the goals set out in Challenge 2008, the Six-Year National Development Plan. The Industrial Development Bureau (IDB) of the Ministry of Economic Affairs (MOEA) provides assistance to all industries and businesses, and has divisions dealing with industry policy, industry development, knowledge services and electronic information.

Unlike the NICI, CEPD, and IDB, the National Communications Commission plays a regulatory rather than a planning role. The National Communications Commission was established on 22 February 2006 as an independent regulator governing the telecommunications, media, and information sectors. Authority over telecommunications and broadcasting that was originally under the Ministry of Transportation and Communications (MOTC), Government Information Office (GIO), and Directorate General of Telecommunications (DGT) was transferred to the National Communications Commission. Its key functions include licencing, enforcement, spectrum assignment and management, technical standards, regulation of information and communication security, and consumer protection. As an independent regulator, the National Communications Commission is not a member of the Cabinet and it is not under the supervision of the Executive Yuan.

However, according to Article 3 of the Communications Basic Law, national communications resources planning and the provision of guidance and incentives for industry development are to be performed by subordinate organizations under the Executive Yuan. Therefore, the MOTC and GIO still play a role in providing guidance and incentives to the telecommunications and broadcasting industries.

Among non-profit ICT organizations, the Industrial Technology Research Institute (ITRI) is the largest in Taiwan. It was founded in 1973 by the MOEA to meet the technological requirements of Taiwan's industrial development through applied research and technical services. It serves as the technical centre for industry and makes recommendations regarding industrial policy to the government.

Another non-profit organization, the Institute for Information Industry (III), serves as a joint government-private sector think tank to promote the development of the ICT industry (Taiwan Yearbook 2007). It proposes ICT policies to the government and provides the private sector with market analysis, ICT training,

interoperability standards, services and technology transfer (Dahl and Lopez-Claros 2005). It assisted the Science and Technology Advisory Group (STAG) of the Executive Yuan to implement the e-Taiwan Program, and it plays an important role in promoting digital content.

ICT AND ICT-RELATED INDUSTRIES

There are four fixed-line networks in Taiwan. Chunghwa Telecom (CHT, www.cht.com.tw) is the incumbent carrier. In 2000, the government granted three new fixed-line licences to Taiwan Fixed Network, New Century Infocomm Tech Co. and Asia Pacific Broadband Telecom (APBT). CHT is also the largest carrier in terms of market share, accounting for 51.8 percent of revenues for international services, 80.7 percent for domestic long-distance services, and 97.4 percent for local telephone services as of December 2006. CHT became a private company in August 2005, although government still owns 35.41 percent of its shares. In 2007, its total revenues were USD 5.82 billion.

Because CHT controls the last mile, the other three new fixed-line networks cannot compete with it in the local phone market. Although the government has allocated NTD 30 billion (about USD 98.4 million) to build the second backbone for the new entrants, this has not been successful and the new entrants have suggested that CHT's last mile be made public property so that other fixed networks can utilize it without paying high fees as they are doing now (Liu 2008). Although the National Communications Commission has designated CHT's last mile as bottleneck facilities and it has asked CHT to reduce user fees for its competitors, the new entrants are still not satisfied with CHT's dominance in the market and are proposing that WiMAX technology be used for the last mile.

Broadband services rely on the last mile as well, which means that CHT's branch company, HiNet, dominates 84 percent of the broadband market (TWNIC 2008). Because the new fixed-line networks still have problems regarding access to the last mile, they prefer to promote broadband services to small and medium-sized businesses and buildings that have access to high-speed Internet.

The mobile phone industry is composed of six two generation (2G) operators belonging to three telecom groups — Chunghwa Telecom, Taiwan Cellular Corp., and Far Eastone Telecommunications Co. As of December 2007, their market shares were as follows: Chunghwa, 40.28 percent; Taiwan Cellular, 31.38 percent; and Far Eastone, 28.34 percent. Five mobile phone companies provide 3G services. The first 3G service started in July 2003, while the other four operators came two years later.

The big telephone companies are all striving to implement Fixed Mobile Convergence (FMC) or triple play strategies. After

its merger with Taiwan Fixed Network and given its ownership of Fu Yang Cable TV, Taiwan Mobile Network has the greatest advantage to implement FMC and in fact started to adopt a triple play (mobile phone, cable TV, and cable modem) strategy in March 2008. On the other hand, CHT, which has the advantage of owning the last mile, combines IPTV, ADSL and the local phone in its triple play strategy. Cable operators that do not own telephone companies have applied for local phone licences to provide triple play services.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Taiwan is widely recognized as an East Asian development model for its aggressive efforts in strengthening locally developed advanced technologies through government leadership (Wang 2003). For example, the government-led e-Taiwan Program was launched in May 2002 with the vision of transforming Taiwan to an 'e-Society, e-Industry, e-Government, and e-Opportunity'. The e-Taiwan Program upgraded urban IT infrastructure and brought international attention, with Taipei being recognized in 2006 as the 'Intelligent Community of the Year' by the Intelligent Community Forum for demonstrating 'sustainable competitiveness' in its use of broadband technology for economic development (Liu and Wang 2007). The e-Taiwan program also made broadband networks, such as Direct Subscriber Line (DSL) and cable modem, available and affordable for remote and rural residents, and the number of broadband subscribers grew to over 4.6 million by the end of 2007 (FIND 2008).

Following the establishment of a robust island-wide broadband infrastructure, the government launched the m-Taiwan Program in 2005 and the u-Taiwan Program in 2007 with the aim of transforming Taiwan into a ubiquitous network society. The plan is to invest NTD 37 billion (about USD 1.21 billion) in the m-Taiwan and u-Taiwan initiatives from 2005 to 2009, and to develop the infrastructure for wireless Internet access for eight million subscribers and to provide broadband Internet coverage to 80 percent of the population in urban areas. Moreover, seamless wireless networks established under the m-Taiwan program are expected to help solve the last mile problem.

To build seamless wireless networks with advanced technologies such as WiMAX, the government recently collaborated with the private sector, in particular leading computer brand Acer and global companies like Intel and Nortel, and the National Communications Commission issued six licences for WiMAX technology in July 2007. The hope is that the pro-WiMAX policy will enable last mile wireless broadband access (see 'Opening up WBA Licences').

Opening up WBA Licences

Under the m-Taiwan initiative, the WiMAX industry is expected to take off in 2008. Before the government issued Wireless Broadband Access (WBA) licences, some critics thought opening up the WBA licences was premature (*DigiTimes* 2008). However, the government thought that if Taiwan started WiMAX development earlier, it would have a chance to participate in setting the technology specifications and standards, and it can position itself as an industry leader rather than a follower. Since the Executive Yuan was very supportive of WiMAX, the National Communications Commission finished its licencing scheme in 2006 and issued six regional WBA (with WiMAX as one of the standards) licences in July 2007. The hope is that Taiwan's early promotion of WiMAX will attract foreign investment and hasten the development of the WiMAX terminal device manufacturing and WiMAX application service industries.

Indeed, under the m-Taiwan Applications Promotion Project led by the MOEA, Taiwan is the world's largest demonstration area for WiMAX applications and services. The WiMAX Forum has established the first WiMAX testing and certification laboratories in Taiwan, and large multinational companies such as Intel, NEC and Nortel have entered into agreements with Taiwanese companies. In April 2008, Intel signed a memorandum of understanding (MOU) with the MOEA promising to invest half a billion US dollars from 2008 to 2013 in 'across-the-board procurement and investment in Taiwan, including WiMAX' (Emigh 2008). Taiwan ranks second in the world, after the USA, in total investments in WiMAX (*Intelligent Times* 2008).

(Sources: *DigiTimes* 2008; Emigh 2008; *Intelligent Times* 2008)

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

At present there are three electronic media laws (the Radio and Television Act, Cable Radio and Television Act, and Satellite Broadcasting Act) and one Telecommunications Act. However, with the convergence of telecommunication and broadcasting, many laws and regulations have become outdated.

Article 16 of the Fundamental Communications Act states that the government shall amend the relevant statutes within two years of the National Communications Commission's establishment. Thus, in 2007, there were discussions about whether the Telecommunications Law and laws related to electronic media should be amended individually or integrated into one law (*DigiTimes* 2007). The National Communications Commission decided to integrate the four laws and submitted the draft converged law to the Executive Yuan in December 2007. Prior to submitting the draft to the Executive Yuan, the National Communications Commission held several public hearings at which various communication scholars and experts, public interest groups, and representatives of the telecommunication and broadcasting sectors expressed their concerns about the draft. It was felt that more discussion and dialogue was needed. Thus, it came as no surprise that the Executive Yuan returned the draft of the integrated law to the National Communications Commission in April 2008. The National Communications Commission must now decide whether to revise the four laws individually or to submit a revised draft of the converged laws to the new administration.

In addition to the convergence issue, the universal service issue has also caught the National Communications Commission's attention (see 'Broadband Access to Every Village').

DIGITAL CONTENT INITIATIVES

Taiwan's digital content industry is expected to create new job opportunities and employ over 70,000 people. In addition, its production value is projected to reach NTD 600 billion (about USD 19.68 billion) by 2011. Given the industry's size and the magnitude of its contribution to the Taiwanese economy, the government is committed to fostering digital creativity and innovation through various promotional initiatives and regular funding programs. The Digital Content Promotion Office under MOEA oversees these initiatives and programs. Its mission is to promote mobile content/services, online games, 2D/3D animation, software and streaming video products. A recent initiative is a training project by the MOEA in collaboration with leading online entertainment market player Sony Computer Entertainment (MOEA 2008).

The Cultural and Creative Industries Promotion Office aims to upgrade the business turnover from USD 12.20 billion to USD 18.59 billion and to increase jobs in the cultural and creative industries from 186,000 in 2006 to 280,000 by 2008. The program will also attempt to increase the ratio of household cultural expenditures from 13.5 percent in 2006 to 15 percent in 2008.

In 2007 the National Digital Archives Program (NDAP) received a boost with the participation of nine public institutions,

among these the Council for Cultural Affairs, the Council of Indigenous Peoples, the Chinese Taipei Film Archive of the Government Information Office and the National Archives Administration. One of the primary goals of the NDAP at this stage is to upgrade the NDAP through state-of-the-art ICTs such as Web 2.0.

ONLINE SERVICES

Like other countries with rapidly expanding broadband Internet coverage, Taiwan's government and commercial service providers are investing heavily in online services. Total revenues from Taiwan's e-commerce market, including online sales and online purchasing, increased by 10 percent from NTD 185.5 billion (about USD 6.08 billion) in 2006 to NTD 193.5 billion (about USD 6.35 billion) in 2007 (Taiwan External Trade Development Council 2007). The entire e-commerce market is expected to reach NTD 254.7 billion (about USD 8.35 billion) in 2008.

With the expansion of the broadband subscriber base, Taiwan's online gaming market has grown by 13 percent since 2006 with sales reaching NTD 8.4 billion (about USD 275.5 million) in 2007 (Market Intelligence Center 2007). Some big online game developers, such as Chinesegamer Co., have also joined the m-commerce market with mobile games and other mobile value added services (VAS).

Emerging e-government services supported by broadband networks are contributing significantly to e-Democracy in Taiwan. When they log on to the e-government portal (http://gov.tw), Taiwanese citizens are able to access policies, project updates, research reports, and public opinion surveys. Most citizens now file their tax returns, pay their traffic fines and apply for documents online.

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

Taiwan takes pride in its high-speed and low-cost educational online networks at all levels. All elementary schools, junior and senior high schools and universities nationwide are connected via the Taiwan Academic Network (TANet). TANet has in fact grown to be one of Taiwan's three major ISPs. It supports the Academia Sinica,[1] as well as e-libraries and e-periodicals, email, server hosting, over 4,000 English domain names (edu.tw), IPv6, e-learning, academic e-document exchange, video-conferencing, and information security for schools.

To ensure the success of e-learning programs, the digital divide between students in urban and remote areas is being addressed by the Ministry of Education through 300 Digital Opportunity Centers (DOC, http://itaiwan.moe.gov.tw/) in 168 rural villages. The goal is to broaden social participation in ICT applications and to provide education for all by 2008. The DOCs have state-of-the-art computer equipment donated by large companies such as Acer and HP. At the DOCs, less privileged and aboriginal students and residents, including the elderly, can take computer literacy courses that introduce basic email usage, e-learning fundamentals and e-commerce essentials. Although the DOC project has not yet been shown to significantly reduce the

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Broadband Access to Every Village

Article 12 of the Fundamental Communications Act stipulates that the government shall take necessary measures to promote the right of access to communications and the provision of universal service. Accordingly, the National Communications Commission revised the universal service regulation in December 2006 and incorporated broadband access within the scope of universal service. After finding out that all 46 remote villages with no broadband can be wired with only NTD 96.5 million (about USD 3.165 million), the National Communications Commission prioritized the 'Broadband Access to Every Village' project and completed it in late December 2007. Under the project, CHT, the dominant carrier, provided broadband access to 43 remote villages, while Taiwan Fixed Network Corporation provided broadband access to three remote villages. The two telephone companies can recover their losses from the universal service fund to which all telecom carriers with more than NTD 200 million (about USD 6.56 million) in capital contribute.

This universal service policy has helped reduce the digital divide between urban and rural areas and increase digital opportunities to remote villages. Broadband access enables e-learning programs. It also promotes tourism and agriculture in remote areas. Indeed, Taiwan became the first country in the world to introduce broadband access to every village under the mechanism of the universal service fund.

(Source: Liu 2003, 2008)

divide between the information haves and the information have-nots, the program is helping to upgrade the ICT skills of local residents, with the e-training courses and free Internet services reportedly attracting some over-70-year-old residents. In fact, more elderly residents in remote areas are maintaining their own weblogs.

To help address the digital divide in Asia Pacific, Taiwan proposed the APEC Digital Opportunity Center (ADOC, http://www.apecdoc.org/). Launched in 2004, the ADOC aims to transform the digital divide into a digital opportunity, and to prepare APEC economies to use ICTs as a passport to the new economy.

OPEN SOURCE AND OPEN CONTENT INITIATIVES

With the support of Academia Sinica, Creative Commons licences have been translated into the local copyright context. In addition, the Open Source Software Foundry (OSSF, http://www.openfoundry.org/) based at Academia Sinica and funded by the government has been working on further advocacy of creative commons and open content projects and encouraging the use of free and open source software (FOSS). Specifically, the OSSF is building a database of FOSS experts in Taiwan, developing Web-based tools for FOSS licence agreements, and encouraging the development and use of more free and open source Chinese language software. It conducts analyses of FOSS licences and national policies worldwide, and provides training courses to users and helps project owners choose the appropriate FOSS licences.

A recent initiative was Taiwan's hosting of the 2008 Open Tech Summit introducing open source and free content to an international audience held on 24–29 April 2008.

ICT RESEARCH AND DEVELOPMENT

In keeping with its vision of achieving the status of an advanced knowledge-based economy by 2010, Taiwan launched the National Si-Soft Project in 2003. Its goal is to transform Taiwan's IC industry from being mainly contract manufacturing to being R&D and innovation-oriented. More specifically, the project intends to make Taiwan the one-stop shop for IC design, mix-and-match intellectual properties, manufacturing and testing. With a target research and development (R&D) investment of USD 116.21 million, the project is expected to develop, by 2010, IC-related product outputs (including automation software, silicon intellectual property, embedded software and system single chip) totalling USD 14.47 billion.

CONCLUSION

The e-Taiwan, m-Taiwan, and u-Taiwan initiatives provide a clear direction for the growth of the ICT industry in Taiwan. But determination to implement these policies and collaboration among the relevant government agencies are also crucial to maintain Taiwan's competitive edge in the global ICT industry. For example, the ICT industry could have performed better after the National Communications Commission was established in February 2006 had there been no tension between the DPP-led Executive Yuan and the National Communications Commission. Now that the opposition party has won the legislative and presidential elections, the Taiwanese people are pinning their hopes on the new administration to help Taiwan to further improve its economy and strengthen its competitiveness. The Executive Yuan, the Legislative Yuan, and the National Communications Commission are expected to work closely in implementing Taiwan's ICT policies and regulations.

The political climate between Taiwan and China is also important to Taiwan's ICT performance. Taiwan's ICT industry has built many firms in China where labour is cheap and land prices are low. These firms produce 70 percent of China's IT output (Lin 2005). Having regular direct flights between Taiwan and China would save the Taiwanese firms a lot of time and money, which would translate to even higher productivity.

Finally, although Taiwan's ICT technology is advanced, the country needs to do more to improve industry standards and technology innovation. This is especially true in the case of WiMAX technology specifications and standards given Taiwan's early adoption of WiMAX licences.

NOTE

1. Founded in 1928, Academia Sinica leads and pioneers scholarly research in the sciences and humanities. It is the most internationally renowned academic institution in Taiwan. Affiliated with the presidential office, Academia Sinica has continually enjoyed independence and autonomy and it has guided the Taiwanese research community in international collaboration and ground-breaking research.

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.th

Thailand

Thaweesak **Koanantakool**, Kalaya **Udomvitid**,
and Chadamas **Thuvasethakul**

Total population	63.04 million (December 2006)[a]
Literacy rate	98.1% (December 2005)[a]
	(male = 98.2%; female = 97.9%)
GDP per capita (PPP)	USD 9,331 (2007)[b]
Computers per 100 inhabitants	26.8 (2007)[c]
Fixed-line telephones per 100 inhabitants	11.7[d]
Mobile phone subscribers per 100 inhabitants	78.86 (June 2007)[e]
Internet users per 100 inhabitants	20.85 (June 2007)[f]
Domain names registered under .th	35,082 (March 2008)[d]
Broadband subscribers per 100 inhabitants	2.59[d]
Internet domestic bandwidth	162.93 Gbps (April 2008)[d]
Internet international bandwidth	26.33 Gbps (April 2008)[d]

(Sources: [a]National Statistic Office 2005; [b]World Bank 2008; [c]Thailand National Statistical Office 2007; [d]NECTEC 2007, 2008; [e]Office of the National Economic and Social Development Board 2007; [f]Koanantakool 2007)

INTRODUCTION

Thailand's main industries are electronics, automobile manufacturing, and agro-industry. Thailand is also the world's largest producer and exporter of rice. The Thai government recognizes that information and communication technology (ICT) has an important role to play in the enhancement of economic productivity, as well as in the transformation of Thai society into a knowledge-based society. Thus, ICT, telecommunications, broadcasting, and innovation issues are well addressed in the Constitution of Thailand (2007). Furthermore, the Computer-Related Crime Act was enacted in 2007 to make the Internet safer and more secure for every citizen. In addition, Thailand's second ICT Master Plan (for 2009–2013) is currently being drafted.

However, there are a number of challenges with respect to ICT development in Thailand, namely, the establishment of a fair and competent regulatory body for telecommunications and broadcasting, bridging the digital divide, and building confidence in e-commerce.

TECHNOLOGY INFRASTRUCTURE

Rapid developments in broadband services and mobile phone usage are driving the development of technology infrastructure in Thailand. More specifically, progress is being made in Internet Protocol version 6 (IPv6), grid computing, broadband wireless, computer security, and Web 2.0 and Web services, while trials are being conducted for the shift to third generation (3G) mobile services, Worldwide Interoperability for Microwave Access (WiMAX), and digital broadcasting.

The Ministry of Information and Communication Technology (MICT) announced in 2007 the Thailand IPv6 Development Plan (www.thailandipv6.net), which aims to make the next-generation Internet Protocol (IP) available in Thailand by 2010. IPv6, which extends IP addresses from 32 bits to 128 bits, is expected to solve the shortage of Internet address space currently associated with the 20-year-old Internet Protocol version 4 (IPv4). Although the transition from IPv4 to IPv6 is planned to take place within the next two years, Internet users in Thailand can now join the experimental IPv6 network test bed (www.ipv6.nectec.or.th/testbed.php) started in 2003 by the National Electronics and Computer Technology Center (NECTEC), Communication Authority of Thailand (CAT), and Telephone Organisation of Thailand (TOT). By September 2007, five domestic peering nodes and 35 international peers had joined the test bed project. Moreover, to introduce IPv6 to the public, NECTEC has developed the IPv6 Tunnel Broker that allows Internet users to experience IPv6 on their existing IPv4 networks.

Thai telecommunication operators are also planning the introduction of broadband wireless services such as 3G, WiMAX, and High Speed Packet Access (HSPA). As of January 2008, the National Telecommunication Commission (NTC) had granted licences to 12 operators[1] to conduct commercial, six-month trials of broadband wireless access services. Operators will run WiMAX trials on two frequency bands of 2.3 GHz and 2.5 GHz. In April 2008, all mobile phone operators and the MICT jointly declared their readiness to cooperate in testing HSPA and other 3G services.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

There are several key organizations dealing with ICTs in Thailand. The MICT coordinates all ICT development according to the ICT Master Plan and the IT 2010 Policy Framework. The Software Industry Promotion Agency (SIPA) is an arm of MICT. The NTC is the telecommunications regulator. The National Electronics and Computer Technology Center (NECTEC) is a research institution for ICT development.

The SIPA (www.sipa.org) is a public organization that promotes the Thai software industry by rapid skills enhancement for software developers, expanding employment opportunities in the industry, and stimulating growth of the domestic and international markets. The SIPA's development guidelines (2005–2009) aim to sharpen Thailand's competitive edge in software outsourcing, particularly for enterprise software, animation and multimedia, mobile applications, and embedded software. The organization's main focus is building a pool of experts and qualified companies to drive the development of the industry. The SIPA also supports key activities to promote the industry, namely: the annual ICT market survey, ICT awards, and open source software development and usage. Recently, the SIPA proposed a tax incentive scheme to promote software businesses to the government. The scheme is under review by the Board of Investment (BOI).

As an independent regulator, the NTC (www.ntc.go.th) is a special body that reports directly to the upper house of the Parliament. It sets categories of telecommunication services, manages the use of the spectrum for telecommunication services, and grants licences to telecommunication operators. In 2006 the NTC established three new institutes: the Telecommunications Research and Industrial Development Institute (TRIDI), the Telecommunication Consumer Protection Institute (TCPI), and the Interconnection Institute (ICI). TRIDI's mission is to promote the development of the telecommunication industry, including local hardware, software, applications, and content. TRIDI collaborates with universities around the country to promote them to become research and development (R&D) centres in telecommunications. R&D centres are given research funds for students who are doing their master and doctoral degrees and for faculty and project leaders conducting R&D related to telecom technology. The TCPI focuses on consumer protection enforcement. It collaborates with independent consumer organizations to create a consumer protection network and to revise existing regulations to better serve telecom consumers. The ICI's main role is to coordinate with the regulator's Interconnection Settlement Panel to handle disputes between and among telecom operators.

NECTEC (www.nectec.or.th) is a statutory government organization under the National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology. Its main responsibilities are to undertake, support, and promote the development of software, microchip, and electronics clusters through R&D activities. NECTEC has taken a leading role in exploring new opportunities in ICT and it has provided ICT infrastructure to the country since the beginning of the 1990s. NECTEC's work includes SchoolNet Thailand, the Government Information Network, the Thai Computer Emergency Response Team (ThaiCERT), the Software Park, IPv6, Open Source Software, RFID, and IT laws (in cooperation with MICT). More recently, NECTEC has worked on the Annual ICT Market Survey (in cooperation with SIPA and Software Park Thailand), online real-time traffic report system, experiments using Wireless Fidelity (WiFi) and WiMAX for rural broadband services (in cooperation with NTC and TOT), development of a high-capacity e-learning system, and coordination with many other ministries with respect to data warehouses, training, and IT standardization (in cooperation with the Thai Industrial Standards Institute or TISI).

ICT AND ICT-RELATED INDUSTRIES

In 2007 the total value of the Thai ICT industry was about THB 538 billion (about USD 15.96 million[2]), representing a 9 percent growth from 2006. The rapid growth of the ICT industry has contributed to enhanced productivity in both business and government sectors. The ICT-related industry (electronics and parts), in particular the hard disc drive sector, is also a big contributor to the Gross Domestic Product (GDP).

The ICT market in 2007 was dominated by communication equipment and services (THB 391,218 million, or 72.7 percent). ICT spending on computer hardware, computer software, and computer services amounted to THB 68,719 (12.8 percent of the total ICT market), THB 57,178 (10.6 percent) and THB 20,703 million (3.8 percent), respectively. The ICT market in 2008 is expected to grow 13.1 percent from the previous year (Pornwasin 2008) and predicted to reach THB 608.5 billion. The largest growth is expected in computer services at 26.9 percent, followed by computer software at 17.6 percent. The hardware market is projected to grow 6.8 percent and communication services 12.9 percent. Enterprises spent more than twice what government did on ICT in 2007.

In 2007, growth in the computer services sector was 17 percent, higher than the 9.8 percent and 14.2 percent growth of the hardware and software sectors, respectively. Market growth in 2008 is expected to be driven more by government spending on continued investments in infrastructure development projects.

In the communication industry, the mobile handset market in 2008 is still growing (by value), but at a slower rate than in previous years. Low-cost mobile handsets will be the main driver of mobile handset growth (9.8 percent) and service growth (12.4 percent). The data communication service sector is anticipated to be the biggest growth area for 2008 at about 20.9 percent.

Thailand has been the world's largest exporter of hard disc drive (HDD) and supplied parts since 2005, with more than 40 percent share of the world market. The HDD export value was THB 532,955 million in 2006, a 35.25 percent increase from 2005. In 2003, the Thai government, through the BOI, launched an investment promotion policy called the STI (skill, technology, and innovation) program. STI gives longer tax breaks to investors who invest in or support R&D or skilled-worker training in high-technology industries located in Thailand. The policy became much more aggressive in 2004 when the NSTDA established the Hard Disc Drive Institute (HDDI) to support human resource development for the industry (Brimble 2003; Sutharoj 2008).

With support from the HDDI/NSTDA, the top brands in the HDD industry are expanding their production facilities and adopting more advanced manufacturing processes. This trend will become stronger as more engineers complete their training in the government-funded capacity-building program (details in the section on 'Capacity-building').

The Thai animation and games industry had an average annual growth rate of 50 percent in 2004–2006, with a value of THB 10.2 billion in 2006 (SIPA 2007). Of this, 4.5 billion came from the animation industry and the remaining 5.7 billion came from the game industry. However, although its market value is high, the Thai game industry accounts for only 0.6 percent of the world's game market. The SIPA survey also found that more than 90 percent of the value of the industry came from imported game software.

Recognizing its potential, the SIPA has identified digital content as one of the key industries to develop and promote. The SIPA is targeting revenues of THB 30 billion from digital content by 2010. Since 2004 SIPA has been organizing an annual event called Thailand Animation and Multimedia (TAM), to serve as an arena for industry players to exchange knowledge, to learn new knowledge and technologies, to establish connections, and to explore business and partnership opportunities. It is also an event for young amateurs, professional animators, and graphic designers to showcase their latest work. In 2007, the SIPA opened the Bangkok Digital Content Centre as a facility where animation and game developers can use development tools, such as motion capture, to develop their products (Sambandaraksa 2007; Solomon 2008).

As the Thai government has positioned the country to be a 'Healthcare-Hub',[3] many hospitals have improved their services by using ICT to support their operations. Through its IT subsidiary company, Global Care Solutions (GCS), Bumrungrad Hospital has become a leading user of ICT in medical services. In October 2007 Microsoft acquired the GCS system, which is now being used by seven hospitals in Asia Pacific (Microsoft 2007). The acquisition expands Microsoft's portfolio in the healthcare industry while giving the privately owned Thai IT provider access to worldwide markets.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Although many ICT indicators, such as number of Internet users and international Internet bandwidth, point to a considerable increase in the utilization of ICT in Thailand, the digital divide between the Bangkok metropolitan areas and the rest of the country remains significant, as suggested by household computer ownership data and Internet user profile statistics. To bridge the digital divide and enable the shift to a knowledge-based economy, Thailand's national ICT policy focuses on infrastructure and knowledge building (Koanantakool 2006; National Information Technology Committee 2002; Thuvasethakul and Koanantakool 2002).

Since 2002 ICT development in Thailand has been guided by the first ICT Master Plan (2002–2006) that is part of the policy framework called IT 2010. This framework emphasizes five flagship applications: e-industry, e-commerce, e-government, e-education, and e-society. NECTEC and the MICT have been assigned to complete the second ICT Master Plan for the period 2009–2013, and to prepare ICT 2020, the national ICT policy framework for the next decade.

As a member of the World Trade Organization (WTO), Thailand committed to free and open competition in the telecommunications sector by 2006. In this connection, the government has formulated the Telecommunications Business Master Plan (for 2005–2007) that provides guidelines for (Tilleke and Gibbins n.d.):

- Regulating and supervising the telecoms market to increase competition through liberalization;
- Management of telecommunications resources;
- Impartial expansion of telecommunications services nationwide;
- Supporting and developing the telecommunications industry, including the use of telecommunications to support education, religion, culture and security among others; and

- Preparing the use of telecommunications during emergencies/crises.

The first Telecommunication Master Plan was extended to March 2008, after which the second master plan took over. Compared with the first plan, the new Master Plan is less restrictive in approach, emphasizes the public interest more, and more clearly spells out the development time frame. For example, the licensing framework for 3G is to be completed in 2008 and the frequency allocation framework in 2009.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Two major laws were enacted in Thailand in 2007 — the Constitution of the Kingdom of Thailand, which has a section addressing the regulatory regime for the telecommunication and broadcasting business, and the Computer-Related Crime Act, which intends to make the Internet safer and more secure for every citizen. In early 2008 the revised version (second edition) of the Electronic Transactions Act of 2001 was also enacted. With these laws in place, the volume of electronic transactions, with a market value of approximately THB 305,159 million in 2006, is expected to increase.

The new Constitution of Thailand, B.E. 2550 (A.D. 2007) addresses technology convergence by mandating the merger of two regulatory bodies into one organization with the power to regulate both telecommunication and broadcasting. Specifically, the new Constitution requires the newly elected members of Parliament to establish a new agency in charge of radio frequency spectrum management and supervision over the operation of broadcasting and telecommunications businesses within 180 days from the time the Constitution took effect.

The Computer-Related Crime Act has been in effect since July 2007. This long-awaited law was drafted in 2004 and has gone through a series of revisions. It is expected to create a safe environment for Internet users in Thailand through the definition of computer offenses, empowerment of law enforcement officers to deal with computer crimes and crimes committed via a computer or the Internet, and definition of duties of service providers. The law lists the following as offences: unlawful access to computers or network resources, unauthorized interception of email or data transmission, sniffing, spamming, hacking, and disseminating false or pornographic content. There are additional penalties for offenses that may cause damage to national security, the economy, and society at large.

Law enforcement agencies are expected to be more effective in dealing with cybercrimes as competent officers now have authority to search for and seize electronic evidence, under supervision of the courts. They are also empowered to stop service providers from disseminating offensive content. The minister of ICT is responsible for the enforcement of this law, as well as issuing orders and appointing competent officers. To preserve evidence, the law requires service providers (e.g. Internet Service Providers — ISPs — or telecom companies) to keep a record of traffic data for at least 90 days.[4]

The e-Transaction Act of 2001 encouraged businesses and government agencies to adopt electronic transactions to improve efficiency. But increasing demands for use of electronic documents called attention to gaps in existing laws, such as the need to define the electronic equivalent of the duty stamps required under business laws. In 2006, the office of the prime minister and NECTEC conducted a study that resulted in recommendations to revise the e-Transaction Act to fill in the gaps. The revised law, enacted in February 2008, allows for the use of electronic documents and print-outs as court evidence. It also changed the secretariat of the e-Transaction Commission from NECTEC to a unit under the MICT.

The e-Transaction Act also requires the issuance of several Royal Decrees. The Royal Decree on e-government transactions has been in effect since January 2007. It specifies that government agencies must have a security policy and a privacy policy before they operate e-services. Two additional Royal Decrees relating to the supervision and governance of Certification Authorities (CAs) and e-payment service providers have been endorsed by the Cabinet and are now under review by the Council of State. Once these decrees are enacted and with appropriate enforcement mechanisms in place, trust and confidence in the use of e-transactions will be enhanced considerably.

DIGITAL CONTENT

Local language websites and other forms of media (e.g. Compact Disc-Read Only Memory — CD-ROM — or e-books) are being developed to give Thai people more access to all kinds of practical information, such as information about jobs, the traffic situation, weather forecasts, news, shopping, language training, e-learning, and social networking. In addition, local language platforms facilitate knowledge-sharing and participation in e-society.

Information and knowledge exchange channels like e-groups, blogs, wikis, and YouTube are now widely used. Weblogs or blogs have grown more popular over the past few years, with Thai users now numbering in the thousands. The top blog sites are exteen.com, BlogGang by pantip.com, storythai, GotoKnow.org, and oknation.net by the Nation Multimedia Group.

Wikipedia in Thai (th.wikipedia.org) started in December 2003. As of April 2008 there were 35,150 Thai Wikipedia articles, 42,717 registered users, 18 editors, and about 150,000 visitors per day. Truehits.net ranks Thai Wikipedia as the 31st most popular website in Thailand.

In 2007 the Ministry of Science and Technology launched an online 'smart' traffic report that allows drivers to determine road-traffic conditions from coloured scalable maps on mobile phones equipped with General Packet Radio Service (GPRS) and Java. The program for mobile phones can be downloaded for free from http://traffic.thai.net. Users can also get information on the traffic condition of any road in Bangkok by SMS or instant messaging (e.g. MSN). The project is part of the NECTEC's Intelligent Transport System (ITS) program in collaboration with the Office of Transport and Traffic Policy and Planning and the Bangkok Metropolitan Authority.

The Digital Accessible Information System (DAISY) is a World Wide Web Consortium (W3C) data format standard for talking books. More specifically, the DAISY format is a mark-up language that allows users to get information from mp3 compact discs (CDs) by direct access to chapters, pages, paragraphs, and lines. Talking books in the DAISY format give visually challenged people better access to books than does Braille printing. The project, which is supported by Princess Maha Chakri Sirindhorn, has produced more than 100 book titles and distributed these to libraries/schools for the blind in various parts of Thailand. A recent addition by NECTEC is the audio version of the Thai Junior Encyclopedia initiated by His Majesty the King in 1963.

ONLINE SERVICES

A breakthrough in the e-payment system in Thailand is the launch of the Interbank Transaction Management and Exchange (ITMX) service. The Revenue Department has also successfully introduced a tax filing service via the Internet, or e-Revenue. However, not all government e-services have been successful because many government websites are still underutilized.

As part of the Bank of Thailand's (BOT's) Payment 2004 Policy, a national funds transfer hub was established in 2005 to serve electronic funds transfer across commercial banks (Thai Law Forum 2005; *The Nation* 2005). Now money transfers between accounts can be made across banks using the Internet and mobile phones.[5] The ITMX service was initiated by the BOT (www.bot.or.th) and is operated by the Banking Association of Thailand. The BOT is drafting a law to facilitate use of the ITMX service.

The Revenue Department launched income tax return filing through the Internet in 2001. Both corporate and personal taxpayers found the system convenient. Payments are made through e-banking. Recently, the Revenue Department added tax payment services through mobile phones. For example, short message service (SMS) is used to inform taxpayers who submit tax returns online about tax refund details and individual tax information. As an incentive, online taxpayers are able to access tax refunds within three days (Sirisaengtaksin 2007).

Since June 2007, the Revenue Department has made its website (www.rd.go.th) accessible to everyone, including persons with disabilities, by following Web Content Accessibility Guideline 1.0 of the Web Accessibility Initiative (WAI) of the W3C. The initiative has been implemented on the Thai language version of Web pages on 'Tax Knowledge', 'The Revenue Code', and general information 'About the Revenue Department'. The Department aims to make all such information accessible to everyone in the near future (see 'Thailand's Ranking in the 2008 UN e-Government Survey').

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

In Thailand, using ICT in education and capacity-building programs on a large scale has been plagued by many problems, particularly the lack of focus on students. Most procurement projects are marred by delays and conflicts of interest, and poor content and learning strategies. However, there are attempts to overcome these problems, such as the One Laptop per Child (OLPC) and the e-learning via Distance Learning Television (e-DLTV) projects.

The Thai OLPC team includes NECTEC, Suksapattana Foundation, teachers from Darun Sikhalai School, volunteers from the Prince Royal School, and the Department of Informal Education. A group of engineers and educators participated in the development of Thai language interface on the XO machine[6] in September 2006. OLPC field trials took place at Bansamkha village school in Lampang in May 2007. Two more schools in Nakhonnayok joined the trial programs in October. With the support of the Ministry of Education and NECTEC, about 170 XO laptops have been deployed in experiments in two provinces.

Having a personal laptop allows the children involved in the trials to access the Internet through the wireless network. Their teachers are encouraged to assign self-learning tasks to the children while their parents are learning with them through music, writing, drawing, and taking photographs.

In the e-DLTV project, schools in the rural areas of Thailand are being equipped with satellite TV receivers to utilize 14 simultaneous live broadcasts from the classrooms of Klai Kangwon School in Hua Hin. The project addresses the lack of teachers in remote areas (see 'e-Learning for Distance Learning TV Library for Every School in Thailand').

Thailand's Ranking in the 2008 UN e-Government Survey

Thailand ranked 64th out of 182 countries in the 2008 e-Government Readiness Index of the UN. In 2005, Thailand ranked higher at 46th.

Focusing on 'connected e-Governance', the UN Survey combined 'government' and 'governance' in the use of IT for public sector transformation. Thus the scores account not only for back-office and front-office processes, but also for the whole-of-government value of services that come from connected government. The e-Government Readiness Index is calculated from four sub-indices — the Web Measure Index, Telecommunication Infrastructure Index, Human Capital Index, and e-Participation Index. The Web Measure Index provides UN Member States with a comparative ranking on their ability to deliver online services to their citizens. There are five stages in the Web Measure Index:

Stage 1 — Emerging: showing Web pages and links to ministries; most pages are static and no interaction

Stage 2 — Enhanced: showing more information, well-organized and easy to find

Stage 3 — Interactive: downloadable forms, providing more convenience to citizens

Stage 4 — Transactional: two-way interactions between citizens and government, option to pay tax and apply for licences online

Stage 5 — Connected: government agencies are themselves connected and provide seamless, one-window service

Thailand ranked 50th in the Web Measure Index. The poorest score for Thailand was on the e-Participation index, at rank 62nd, well below Vietnam (18th) and Bhutan (19th). The ranking provides a good opportunity for government CIOs to reflect on how to improve the national performance.

(Source: UN 2008)

To maintain Thailand's position as the number one world exporter of hard disk drives, the Thai government has adopted a Skill, Technology and Innovation incentive package for the industry. Specifically, in August 2004 the NSTDA set up the HDDI, which offers partial financial support for seven HDD-cluster development projects. One of the projects is a training program for engineers and technicians to upgrade the technology capability of Thai-based HDD manufacturers and suppliers, especially in advanced automation engineering. The training program also aims to build the critical mass of engineers in the precision electronics industry and related industries to cope with the big shift to automation. As of the end of 2006, 2,354 engineers had participated in the training program.

A strategic roadmap for the HDD industry, which covers four issues (technology, human resource, supply chain, and policy), has also been developed, and the Cabinet approved in June 2007 a five-year budget of THB 1,360 million for HDDI/ NSTDA to implement the strategic roadmap. The budget is expected to expedite and strengthen technological capability in the electrical and electronic industry, particularly the HDD cluster, through R&D and human resource development. HDDI in turn funds collaborative research between universities and industry in four main areas: automation, electrostatic discharge contamination, materials, and HDD applications. The success of this capacity-building project can be gauged from increased foreign investment by HDD assemblers and the increase in the number of locally based HDD suppliers. BOI statistics indicate that from January 2007 to August 2008, HDD investment in Thailand was approximately THB 60,000 million (USD 1,780 million). The number of HDD and related suppliers (e.g. head gimbal, slider, spindle motor, etc.) had increased from 63 to 70 companies.

OPEN SOURCE/OPEN CONTENT INITIATIVES

The open source movement in Thailand has gone into the mainstream with the regularly held Asia Open Source Software forum and the establishment of the Open Source Software Association. The SIPA and NECTEC support open source developments. Thailand recently launched an open source project, called OpenCARE, aiming to link different information systems for disaster relief coordination. Another important open content initiative is the Thai Telecommunications Encyclopedia.

The OpenCARE (http://opencare.org) initiative came about from the Thai experience of the Tsunami disaster in December 2004. OpenCARE stands for The Open Exchange for Collaborative Activities in Response to Emergencies. Basically, this open source project is an information exchange platform that facilitates information sharing and coordination among relief organizations. It is based on XML (Extensive Markup Language), which allows information sharing by accepting input

e-Learning for Distance Learning TV Library for Every School in Thailand

In December 1995, in honor of His Majesty the King's Golden Jubilee, the Distance Learning Foundation and the Ministry of Education of Thailand launched an educational television through satellite broadcast program called Distance Learning Television (DLTV). Satellite receivers were donated to 3,000 schools each year to implement the distance learning concept and thereby address Thailand's problem of chronic shortage of teachers in the rural areas. The target: 30,000 schools in 10 years.

In 2000, the broadcasting system was modernized and the feeds increased to 14 channels serving 24 hours a day. The complete curriculum for secondary schools was broadcast daily all over Thailand and even to neighbouring countries. Evenings and weekend time slots were allocated to broadcasts for learners of foreign languages such as English, French, German, Japanese, and Chinese.

In 2003, the Telecommunications Association of Thailand got together with a group of companies to set up video servers to stream all of the 14 DLTV channels live on the Internet. All of the previously broadcast programs are online at www.dlf.ac.th. The Internet channel is becoming popular.

In 2007, NECTEC developed an integrated e-learning system with a high-capacity video streaming service for DLTV. With this technology, it is now possible to digitize all of the programs in eight main subjects or learning areas for secondary school and place these into the server, together with the individual presentation and individual lesson plans, quizzes and teacher's notes for each of the lectures.

The new project, called e-DLTV, aims to give one server to each school to create a super-broadband on-demand learning network in the school LAN. The server is based on the open source Linux operating system, Apache, MySQL, and PHP. The content/lesson management system is called LearnSquare, and it is now the most well-known e-learning platform in Thailand. All of the contents are stored on 1.5 terabyte hard disks, and each server can serve 300 simultaneous video viewing PCs in any school through the gigabit Ethernet port. e-DLTV can be used in a classroom environment as well as on an individual basis at the same time. Any terminal can retrieve any lecture from the selection of over 2,000 videos.

The e-DLTV project is part of Her Royal Highness Princess Maha Chakri Sirindhorn's IT Project. The 'source' of all DLTV programs is Klai Kangwol School in Hua Hin, 200 kilometres south of Bangkok. Eight schools have been in pilot operation since December 2007, and a total of 90 schools are targeted for operation in 2008. When completed, this system will be the largest e-learning system available to Thai students.

The e-DLTV project mitigates Thailand's shortage of teachers by providing each school with pre-recorded quality lectures. New technology overcomes the broadcast nature of the satellite and the lack of bandwidth problems by locating the high-capacity server within each school's local network. Moreover, all software used is open source. Thus, the concept is highly scalable. Using the nationwide broadband Internet connection, it will also be possible to implement online content updates to all servers.

(Sources: Boonruang 2008; *Daily News Online* 2008)

from multiple sources and translating the information into a format that each recipient understands and can use immediately. OpenCARE is designed using open standards such as OASIS's Emergency Data Exchange Language (EDXL) and People Finder Interchange Format (PFIF).

OpenCARE services can operate over the Internet, by instant messaging, as a Web portal, and between amateur radio operations. As of 2008, five relief agencies in Thailand have joined OpenCARE. The project, a contribution of Internet Thailand Public Company Limited, is intended to complement

the Emergency and Educational Communication Vehicle (EECV) reported in the 2007–2008 edition of the *Digital Review of Asia Pacific*. The OpenCARE initiative is now part of the ITU-D and is being considered a part of ISO/TC223.

The Thai Telecommunications Encyclopedia project (http://www.thaitelecomkm.org) was initiated by academic members of the ECTI Association of Thailand. It aims to collect knowledge related to various aspects of telecommunication from various experts. The encyclopedia includes the telecommunication development history of Thailand.

ICT RESEARCH AND DEVELOPMENT

As the agency tasked with current and emerging technology R&D, NECTEC has initiated 10 strategic programs. Six of these are on technologies, namely, RFID, HDD, Embedded, Wireless, Sensors, and Security. Two are on engineering: Biomedical and Intelligent/Knowledge. The remaining two programs are on applications: Information and Mobile, and Intelligent Transport System.

Niche areas for each program are shown in the following examples:

- Embedded technology: agricultural applications, consumer electronics, and automotive industries
- RFID technology: reader, antenna, and software development
- Sensors technology: electronics-sensor and bio-sensor

TRIDI, the new telecommunication research institute under NTC, also supports R&D and industry development, particularly in technologies for wireline and wireless broadband access, short-range communications, optical communication such as fiber-to-the-home, and next-generation networking.

CHALLENGES AND OPPORTUNITIES

Thailand is moderately successful in expanding effective use of ICT for development, enhancing competitiveness and productivity, and stimulating the growth of the ICT industry. The big drive for value creation through a 'cluster' approach by integrating research into a high-value industry, such as hard-disk drive production and animation, is noteworthy.

However, three main challenges need to be addressed for Thailand's use of ICT for development to succeed: the establishment of a fair and competent regulatory body for telecommunications and broadcasting, bridging the digital divide, and developing trust in e-commerce.

First, the regulatory body for telecommunications and broadcasting has been reformed through the new Constitution of 2007. Instead of two regulatory bodies (one for telecommunications and another for broadcasting), the new Constitution requires the Parliament to pass a law that will set up the National Broadcasting and Telecommunication Commission (NBTC) as the single regulator for both telecommunications and broadcasting. The new Telecommunication and Broadcasting Bill to establish the NBTC has been drafted and is ready for parliamentary deliberations. The law requires the appointment of NBTC members within 180 days. This is a challenging task because in the past, it took Thailand more than four years to appoint members to just one (of the two) regulatory body.

Second, although Thailand is a leader in supplying low-cost PCs to its citizens, localization of software, putting more Thai language content on the Web, expanding broadband coverage, and lowering broadband prices, broadband penetration in Thailand remains very limited (only 2 percent of the population). While online translation services have been extended from the Web to the short message platform and text-image translation is under development, Truehits.Net statistics show that educational content in Thai is being retrieved by only 2.5 percent of Web visitors. Obviously, the broadband divide and the knowledge divide are big challenges for the move toward a knowledge-based society.

Third, with respect to building a trusted environment for e-commerce, Thailand has achieved three milestones: the enactment of the Computer-Related Crime Law, the establishment of the National Root Certification Authority, and the adoption of central government email services. The latter is an offshoot of the recent ban on excessive use of free email services such as Hotmail, YahooMail, or Gmail, for government data messaging as these violate the official document handling procedure. All three milestones seek to build trust and confidence in electronic document systems, email storage, and the use of electronic certificates to let government officers sign documents electronically. However, the wider use of Public Key Infrastructure that will result in more secure websites with SSL (secured socket layer), and legislation of the Data Protection Act, remain a challenge.

It is hoped that the second ICT Master Plan (2009–2013) currently being drafted will address these challenges.

NOTES

1. The operators granted the testing licences are AIS, United Information Highway, Loxley, TT&T, CAT Telecom, TOT, TrueMove, CS Loxinfo, Trans Pacific Broadband, Samart Telecom, True Universal and Triple T Broadband.

2. USD 1.0 = THB 33.7 (December 2007)

3. The service sector had an economic value of approximately 49 percent of total GDP in 2007 and it is expected to grow further.

4. Although the requirement is perceived to be a financial burden to business, most providers are cooperating with the government and they actually recommended the 90-day period (the draft provided for only 30 days) to gain more trust from user communities.

5. ITMX currently allows for money transfers of up to THB 2 million per transaction, and a cash transfer of up to THB 30,000 per transaction.

6. The XO machine, previously known as the 'USD 100 Laptop' or 'Children's Machine', is an inexpensive laptop computer designed to be distributed to children in rural areas.

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.tl

Timor-Leste

Abel Pires **da Silva**

INTRODUCTION

The official name of Timor-Leste is República Democrãtica de Timor-Leste (RDTL) or Democratic Republic of Timor-Leste. The country declared its independence in May 2002 after a brief United Nations Transitional Administration (UNTAET) following the Popular Consultation (referendum) in August 1999.

Since then Timor-Leste has developed in every sector. In 2002, the Government adopted its first National Development Plan titled *East Timor 2020 — Our Nation, Our Future*. In the telecommunications sector, Timor-Leste has the following vision: 'We want good communication facilities throughout the country, with access to postal services, telephone, Internet, radio and television' (Government of Timor-Leste 2002). It should be noted that practically the entire telecommunications network was destroyed during the violence that erupted following the 1999 referendum. Thus, to achieve its vision for the telecommunications sector, the government of Timor-Leste has focused on restoring telecommunications and postal services, establishing better communication facilities for remote areas, and providing modern telecommunication systems at the national level.

However, in 2006 the country's development was again put on hold due to the violence triggered by the military crisis.[1] Following the Legislative Election in June 2007, President Jose Ramos Horta appointed a new Government of Timor-Leste in early August 2007. The programs of the newly formed government under Prime Minister Jose Alexander Gusmao (popularly known as Xanana Gusmao) were approved by the National Parliament in October 2007. The telecommunications sector is included under 'Infrastructure and Enhancing the Quality of Life'.

The information and communication technology (ICT) sector has great potential to support the national development process.

But greater advocacy efforts are required to promote better understanding of this potential among the government, members of Parliament, and the general public. The lack of a proper legal infrastructure for the ICT sector reflects the lack of an integrated national policy in this area. The sector is also characterized by very limited human resources and inadequate ICT and power supply infrastructure in the country's capital Dili and especially in the rural areas where power and telecommunications infrastructure are non-existent.

TECHNOLOGY INFRASTRUCTURE

Timor Telecom, a private company owned by Portuguese Telecom International (PTI), is the only telecommunications operator in Timor-Leste. It started operations in March 2002 and provides all IT and telecommunications services in the country. Customers have been complaining about its pricing regime and the low quality of service, but Timor Telecom counters this criticism by pointing out that services are expensive due to the high taxation system[2] and the provision of power to all of its operations in Timor-Leste. In 2007 approximately 50 generators were used to provide energy to all of Timor Telecom's sites (Timor Telecom 2007), resulting in very high capital and operational costs. Timor Telecom has also argued that it has not increased prices for its services since 2003, while the cumulative inflation during 2003–2007 has been approximately 20 percent (Timor Telecom 2007).

As of January 2008, there were 2,457 fixed Public Switched Telephone Network (PSTN) subscribers in operation in Timor-Leste, corresponding to a penetration rate of less than 0.25 percent.

However, this number represents a 25 percent increase from the number of services (1,970) at the end of 2003. Most of the services are used by government institutions, international non-government organizations (NGOs), and other international institutions. And most services are located in Dili. There are few Integrated Service Data Network (ISDN) services in operation.

At least two factors would account for the very low access to fixed phone services. First, the network is very limited both in Dili and the districts.[3] Timor Telecom has not expanded the fixed telephone networks. Second, Timor Telecom is charging almost the same rate for fixed line service as for mobile service. Thus, most people opt to use mobiles rather than the fixed telephone services, for flexibility, and better service and mobility.

As of February 2007 Timor Telecom had 78,215 mobile telephone subscribers, compared to 20,000 customers in March 2003 when Timor Telecom first started its operations in Timor-Leste. However, the current total represents approximately less than 8 percent of the population. While the network coverage is around 68 percent of the territory (Timor Telecom 2007), the real access rate is much lower due to very limited access to electricity in the rural areas. In other words, while mobile services may be available in many places, few people actually avail themselves of the service because they do not have electricity.

The high cost of mobile ervice is another reason for the low mobile penetration rate. A World Bank report released in August 2007 predicts that the penetration of mobile services would be even greater (up to 200,000) if prices were to be brought down (World Bank 2007).

Currently, there are two Internet service providers (ISPs) — Timor Telecom and iNet. The latter is owned by an Australian and it began its operations at the time of the UNTAET in 1999–2002. iNet is only a sub-ISP since all its lines are leased from Timor Telecom. This arrangement makes Timor Telecom the sole ISP in the country.

Both Timor Telecom and iNet provide Internet dial-up, dedicated Internet access, and short messaging service (SMS) via the Internet. They also operate several Internet cafés.

Internet access in Timor-Leste is extremely expensive relative to the average income of the people and compared with the cost of Internet access in neighbouring countries. In 2007 Timor Telecom charged a connection fee of USD 35 and a monthly line rental fee of USD 5 for its dial-up services. The peak per minute usage charge was USD 0.079, and the non-peak per minute charge was USD 0.019. For dedicated Internet access, Timor Telecom charges an activation fee of USD 500 and a monthly fee ranging from USD 500 for 64 Kbps and up to USD 3,450 for 512 Kbps. Considering the fact that almost half of the population earns about 50 cents per day and the average monthly salary is less than USD 250, it is almost impossible for the majority of the people of

Timor-Leste to enjoy Internet access. In fact, in 2007, the number of Internet subscribers in Timor-Leste was only around 1,500. Most of these are government offices, international NGOs, private enterprises, and other international institutions. There are some schools and NGOs that currently have Internet access due to financial support from donors. If the rates remain at current levels, then Internet access in Timor-Leste will most likely remain extremely low in the future.

UN agencies, embassies, some government offices, and some international NGOs operating in Timor-Leste have their own private satellite connection via Very Small Aperture Terminal (VSAT). There are also around 15 Internet cafés around Dili and in the districts. The total number of Internet users in Timor-Leste is estimated to be 10,000, or less than 1 percent of the population.

According to the Autoridade Reguladora das Communicações (ARCOM), by 2006 the total international Internet bandwidth in Timor-Leste was 11 Mbps, of which the outgoing bandwidth was 4 Mbps (up from 1 Mbps in 2003) and the incoming bandwidth was 7 Mbps (compared to 2 Mbps in 2003). Half of the outgoing bandwidth is reserved for government institutions.

The official country domain name is .tl. This used to be .tp, for Timor-Portuguese (East Timor's formal name as a Portuguese colony). Some organizations, such as Timor Telecom (www. timortelecom.tp), are still using the .tp domain.

KEY INSTITUTIONS DEALING WITH ICT

Under the newly formed government, the Department of Transport and Telecommunications, which was responsible for telecommunications policy, has been merged with other sectors to form a new Department of Infrastructure, covering public works, electricity, water and urban planning, telecommunications, and transportation.

The ARCOM or the Communications Regulatory Authority was established in 2003 to regulate, supervise, and represent the telecommunications sector (ARCOM Statute Chapter 1 Section 1.2). However, despite the stipulation (in Decree Law No 12/2003, Section 5.2) that the ARCOM's Board of Directors be appointed within 90 days of its entry into force, the Board of Directors has still not been formed and the ARCOM is still operating as a government sub-department. Being financially dependent on subsidies from the government limits the ARCOM's daily functions as a supposedly independent telecommunications regulator. In addition, although the ARCOM is supposed to facilitate the registration of complaints by consumers, there are no effective means for this and it is unlikely that many East Timorese

even know about the ARCOM. Its website (www.arcom.tl) is under construction, and online registration of complaints and other online services will benefit only the few who have access to the Internet.

The Comissão Consultativa (Consultative Body), consisting of representatives of the government, operators, and consumers, is mandated to provide guidance and advice to the ARCOM. But this has also not yet been formed, in spite of the stipulation (in Decree Law No. 11/2003) that the Consultative Body be constituted by mid-2003.

Timor Telecom is the only telecommunications carrier in Timor-Leste. It entered into a concession contract with the government in July 2002 and started operations in March 2003. The concession contract gives Timor Telecom exclusive rights to provide telecommunications infrastructure and services until 2018, with the exception of broadcasting and Internet services, which can be provided by other operators and by Timor Telecom. In 2007, Televizaun de Timor-Leste (TVTL) or Timor-Leste's Television, the national broadcaster, entered into an agreement with an Indonesian satellite provider for its transmission carrier services, rather than using Timor Telecom.

The Australian-owned iNet is the only other ISP in Dili. Established in 2003, iNet has to use infrastructure provided by Timor Telecom, including Internet connectivity and leased lines. However, in 2006, iNet was refused supply of analogue leased lines by Timor Telecom. Despite a directive by the ARCOM, Timor Telecom has not resumed the provision of analogue leased lines to iNet and iNet has taken legal action against Timor Telecom.

Connect East Timor (CET, www.connecteasttimor.com) is a community-based initiative that seeks to address the lack of basic communications facilities in rural and remote areas. By installing very high frequency (VHF) services, CET estimates that approximately 30,000 people in rural and remote areas had access to its services by the end of 2007 (CET 2007). As there is no interconnect agreement with Timor Telecom and in many cases, no infrastructure to interconnect with, the connectivity of the VHF services is limited to the reach of the radio system, which varies with topography and which also requires an expensive transceiver. This system can nevertheless be useful for communication between remote villages (see 'Connect East Timor Radio Communication Pilot Project in Atabae and Lacluta Sub-districts').

Info Exchange East Timor (Info Timor) is a not-for-profit enterprise with a vision to assist in the rebuilding of Timor-Leste using information communication technology to deliver skills development, education, and employment through the creation of a sustainable social enterprise in partnership with the Dili Institute of Technology (www.dit.east-timor.net), Infoxchange

Australia (www.infoxchange.com.au), and the Government of Timor-Leste.

Timor-Leste ICT Association (ICT-TL) was founded in November 2007 by a group of ICT activists to develop the professional skills of its members, to promote ICT applications to support the national development process, and to promote the interests of consumers in the ICT sector in Timor-Leste.

ICT-RELATED INDUSTRY

Because it is a new country, Timor-Leste's ICT industry is also at a very early stage of development. At the time of writing this chapter, there is no software or hardware company with an office based in Timor-Leste.

According to the ARCOM, the total revenue from all telecom services in 2006 was just above USD 23 million. Of this, revenue from fixed-telephone services was approximately USD 4 million while revenue from mobile services was about USD 16.8 million. The rest was revenue from data transmission, including leased circuits.

ICT imports of hardware and software are mainly from Indonesia, Australia and Singapore, and ICT services are provided mainly by foreign companies. Since Timor-Leste does not have copyright laws, pirated compact disc/digital versatile discs (CD/DVDs) and computer software, including games, are sold in stores without restriction. Most of the pirated CDs and DVDs are imported from Indonesia and Malaysia.

KEY ICT POLICIES AND PROGRAMS

The 2007–2012 program of the government elected in 2007 includes the following targets (Government of Timor-Leste 2007):

1. Improve the efficiency of the ARCOM, which must operate in an autonomous fashion and according to the regulations applicable to a public institution in its tasks of approving all communications regulations and inspecting in an appropriate manner the market's agents;

2. Promote the establishment of monitoring stations of radio frequencies throughout the national territory;

3. Evaluate contracts signed with Timor Telecom and study the monopoly system in the area of telecommunications, assessing whether a more competitive environment would be of benefit to the Timorese;

4. Connect additional telephone lines to the districts and increase the coverage area;

5. Increase the number of fixed-telephone lines;

6. Disseminate Internet access throughout the country, interconnect via a data network all of the government departments

Connect East Timor Radio Communication Pilot Project in Atabae and Lacluta Sub-districts

Connect East Timor (CET) is a community-based campaign that seeks to address the lack of telecommunications infrastructure in rural and remote areas of East Timor. CET's campaigns in East Timor and Australia are undertaken by PALMS Australia, an Australian, non-government, international aid agency.

Access to basic telecommunications services in rural and remote areas of East Timor is crucial. It would significantly improve all types of services for people living in rural and remote areas, particularly in the delivery of health and education services for children. Among the services that can be delivered over a basic village radio system are: basic emergency calls (many women die in childbirth because help reaches them too late); expert medical advice and support to community health workers; better coordination of government services at the sub-district and village level; training for health and educational workers; school on the air services to assist with the delivery of school programs in remote villages where there is no teacher (currently children in these villages walk many kilometres to school each day, or board away from their families during the week, or simply do not go to school); support for commercial activities in rural areas; better coordination of family and community activities.

In June 2005, Connect East Timor was successfully piloted in two sub-districts — Balibo and Lacluta. About 20,000 people are being provided with affordable access to basic, solar-powered communications facilities. Specifically, the project has enabled the following:

1. The Balibo Sub-district Administrator's office is networked to eight major villages via a new radio signal repeater.
2. The Lacluta Sub-district Administrator's office is linked to the District Administrator in Viqueque and networked to seven major villages via a new radio signal repeater constructed on a bare site. Two villages that were only accessible on foot had radio equipment 'back-packed' to them.

The local leaders of Atabae sub-district are very happy with the project and in a letter to the Minister of Telecommunications they have said that, 'this radio system has become very important for us and it would be very difficult for us if the radio would no longer be available. It is now a big part of our daily life.'

(Source: Connect East Timor 2007)

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and agencies, and promote the use of communication through Voice over Internet Protocol (VoIP) on that network; and

7. Ensure the coverage of radio communications in the urban areas.

Under the current telecommunications regime, most of these programs can be achieved by the government only through cooperation with Timor Telecom. However, based on the operations of both the government and Timor Telecom over the last five years (2003–2008, which is a third of the contract with Timor Telecom), it seems unlikely that these programs will be realized in the near future. Timor Telecom seems to be focusing its business operations in the capital, Dili.

Timor Telecom should continue to increase its fixed-telephone network coverage, but at the same time the government of Timor-Leste should fulfil its obligations of increasing electricity services in the rural areas and greater decentralization of power to the local administrations to foster economic activities outside the capital city.

Apart from the above, the government is also preparing specific ICT programs for the coming years. These include a government integrated network to interconnect all government offices, a national backbone network that will allow for domestic and international flow of information, district connectivity to connect all 13 district capitals using the national backbone network, and an emergency communications network. The formulation of a National ICT Policy is also being planned.

The establishment of the Consultative Committee would have a positive impact on national ICT development in Timor-Leste. This multisectoral committee is to be given the task of monitoring and advising the regulatory agency on specific matters.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT

Currently there are only two laws applicable to the telecommunications sector in Timor-Leste. Both were promulgated by the

president of Timor-Leste on 22 May 2003. The first (Decree Law No. 11/2003, 'Establishing the Basis for the Telecommunications Sector') establishes the basis for the telecommunications sector while the second (Decree Law No. 12/2003, 'Establishing The Communications Regulatory Authority and Approving the Statutes Thereof') mandates the establishment of the ARCOM.

Much of the de facto legal and regulatory framework for telecommunications is contained in the 15-year concession contract the Government of Timor-Leste signed with a consortium led by Portugal Telecom Internacional (PTI) in July 2002. Members of the consortium formed Timor Telecom in October 2002 and it has a monopoly over all services except for broadcasting infrastructure and the Internet service. UN agencies and foreign governments are allowed to install their own private networks, bypassing Timor Telecom for Internet bandwidth and other carrier services.

The ARCOM, with support from the International Telecommunications Union (ITU), is currently preparing telecommunications regulations for costing and pricing, universal service obligations (USO), number portability, carrier interconnection, numbering, service providers, and the Internet (cyber law), as well as frequency regulations and a new broadcast plan.

There is also a great need for laws and regulations to protect privacy and copyright and to fight cybercrime. In October 2007, one of the political parties presented a taped (by an unknown party) telephone conversation by high-ranking state officials during a National Parliament Plenary session that was accessible to the public. The incident prompted calls for laws and regulations to secure the privacy of Timor-Leste's citizens and to establish secure communication lines within the sovereign institutions of Timor-Leste.

The lack of an integrated ICT development plan and policy makes the development process in this area uncoordinated. Government departments, divisions, or sections are left to apply their own rules and regulations with respect to ICT, as well as their own standards and specifications when it comes to procuring hardware and software.

DIGITAL CONTENT INITIATIVES

There are few websites that use the country's two official languages, Portuguese and Tetum. Most of the existing websites target foreigners as their main users. This is understandable since the Internet penetration in Timor-Leste remains very low. The number of websites written in Tetum is particularly low. One of these, www.suaratimorlorosae.com, is owned by the Suara Timor Lorosae (STL) or Voice of Timor-Leste. This bilingual website

(it uses both Indonesian and Tetum) is the only online newspaper in Timor-Leste. However, most of the website's contents are derived from the print version circulated in Timor-Leste.

Timor Post, the second biggest newspaper, has announced an online version (www.timorpost.com).

The United Nations Integrated Mission in Timor-Leste (UNMIT) website, www.unmit.org, also uses Tetum as one of its language options.

Most government websites are written in Portuguese and English, indicating a great interest on the part of government in informing the world about the progress the country is making. However, the information on these websites is inaccessible to Tetum-speaking Timorese.

Timor-Telecom has managed to register the country's version of the Google search engine with the address www.google.tl. The search engine is in Portuguese, which means few people in Timor-Leste can actually use the search engine.

ONLINE SERVICES

e-Commerce

e-Commerce in Timor-Leste is practically nonexistent as the cost of Internet connections, registering a domain name, and maintaining a Web server is expensive. Another reason is that the electricity supply (even in Dili) is very unstable. Any organization or individual who is willing to maintain a Web server locally will almost certainly have to purchase a generator, which means even higher capital and operational costs.

There is also a lack of locally qualified Web designers and Web developers to develop and maintain highly dynamic and interactive e-commerce websites.

Another reason could be the fact that the three commercial banks in Timor-Leste — the Australia New Zealand Bank (ANZ), the Indonesian-owned Mandiri Bank and the Portuguese-owned Banco Nacional Ultramarino (BNU) — do not provide local credit-card facilities or online banking services. In fact, there are only six automatic teller machines (ATM) in Timor-Leste, all using Timor Telecom's communication links.

e-Government

The Personnel Management Information System (PMIS), a project of the Government of Timor-Leste and the United Nations Development Programme (UNDP) Timor-Leste office, was launched in October 2007 to improve government human resource management and to provide a base for the elaboration of human resource policies. It will allow the government to formulate a variety of management indicators for the entire civil service.

Unfortunately, the objective is not likely to be met in the near future since there is currently no network connectivity between government offices and departments. Furthermore, government institutions are currently using different standards for software and hardware, which would make integration of their systems difficult to achieve.

The Department of Education, with the support of the United Nations Children Fund (UNICEF) Timor-Leste, has developed an Education Management Information System (EMIS) to manage a database of schools.

In October 2007, the Department of Justice, with support from UNDP's Justice Support Project, installed a VoIP system. All of the Department's servers have been migrated to the Linux Operating System.

ICT EDUCATION AND CAPACITY-BUILDING

Timor-Leste has a handful of tertiary institutions that are delivering courses in computer science, computer technology, information management, and information technology. These institutions are: DIT; East Timor Institute of Business (IOB); Timor-Leste National University (UNATIL) with support from the Fundação das Universidades Portuguesas (FUP) or the Foundation of Portuguese Universities; Dom Martinho University; the Instituto Profissional de Canossa or the Canossa Professional Institute owned by the Catholic Church; and Akademi Komputer (AKAKOM) or the East Timor Computer Academy. Almost all of these institutions are facing the same problems — a lack of qualified lecturers and lack of facilities (e.g. computer laboratories, textbooks, and Internet connection).

On the other hand, many government and privately owned institutions, as well as the Catholic Church and international NGOs, are involved in ICT training activities. General computer skills have become a key requirement to get a job in Timor-Leste.

OPEN SOURCE INITIATIVES

Although the community of open source users in Timor-Leste is small, use of the Linux version of Ubuntu is becoming a trend. The pioneers in using this Linux distribution are the Info Exchange East Timor (InfoTimor, http://www.technology.tl/index.shtml) and the Department of Justice, with support from a UNDP Project.

Info Timor, with support from Infoxchange Australia and the state government of Victoria, Australia, is currently distributing free personal computers (PCs) pre-installed with Linux Ubuntu Distro to NGOs, local governments at district and sub-districts levels, and educational institutions in Timor-Leste. InfoTimor is also training users of the freely distributed PCs in how to use Linux (Ubuntu) and the open source office productivity software OpenOffice. One hundred fifty PCs have been distributed and 55 staff members of non-profit organizations trained (InfoTimor 2008).

There is also a spell-checking tool for Tetum for the Open-Office suite developed by Lev Lafayette, Peter Gossner, and Kevin Scannel (Lafayette 2005).

CHALLENGES AND OPPORTUNITIES

There are many barriers to the adoption of ICT in support of Timor-Leste's national development process. One of these is the perception, shared by many government officials, academics and others, that ICT is not a high priority for the country. The abolition of the Department of Transport and Telecommunication and its merger with other sectors under the Department of Infrastructure is an indication of the low priority given by the government to the development of the ICT sector.

Once the government recognizes the importance of ICT for the development of the country and gives higher priority to this sector, the most urgent task is to improve the regulatory environment. This will be a great challenge, as the concession contract giving Timor Telecom a monopoly does not expire until 2017 and the contract does not include any obligations for Timor Telecom to offer affordable pricing or to deploy services in rural areas beyond the district capitals. Unless these shortcomings are remedied soon, the government will not be able to effectively harness ICT as a tool for development.

On the infrastructure side, lack of electricity remains one of the major obstacles in promoting the use of ICT. According to a World Bank report (2007), only 43,500 households (approximately 22 percent of the total population) have access to electricity. Most of these households are in Dili: approximately 85 percent of households in Dili have access to electricity compared to only about 5 percent of households in the rural areas.

The high cost of telephone and Internet services and the very limited number of qualified IT professionals are also among the key challenges in the development of the ICT sector.

On the other hand, because the development of the ICT sector in Timor-Leste is still in the early stages, the country has the opportunity to choose to adopt systems that fit the country's conditions and make use of the latest technologies. For instance, the use of open source software is appropriate given the country's

lack of financial resources (Lafayette 2005). The use of wireless networking technology is a cost-effective solution for the mountainous terrain and the dispersed communities across the sparsely populated country. Wireless technologies in general would be easier to install and they require less maintenance than wire-line services. Moreover, with increasing deployment of wireless services globally and particularly in developing countries, the costs associated with this technology are decreasing.

NOTES

1. Violent clashes erupted from a crisis within the national army, the Timor-Leste Defense Force (Falintil-Forcas Defesa de Timor-Leste or F-FDTL).
2. In July 2008 the parliament of East Timor approved a new taxation system that reduces the telecommunication services tax to 5 percent only. Timor Telecom responded to this by reducing its prices by 10 percent (Timor Telecom 2008).
3. East Timor is administratively divided into 13 districts and each district is further divided into several sub-districts.

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.vn

Vietnam

Tran Ngoc Ca and **Nguyen** Thi Thu Huong

Total population	86,116,559 (2008)
Literacy rate	90.3%
GDP per capita	USD 780
Fixed-line telephones per 100 inhabitants	43.03 (2007)
Mobile phone subscribers per 100 inhabitants	27.16 (2007)
Internet users per 100 inhabitants	23.75 (2008)
Domain names registered under .vn	84,492 (2008)
Broadband subscribers	1,842,856 (2008)
Internet international bandwidth	27,860 Mbps (2008)

(Sources: General Statistics Office of Vietnam 2008; VNNIC 2008)

INTRODUCTION

Information and communication technology (ICT) is one of the top priorities in science and technology (S&T) development in Vietnam. It has been on the agenda of the country's policy-makers since the mid-1970s and investments were made in ICT development in the 1980s and the 1990s. Concrete measures that have taken ICT development in Vietnam to a higher level include the Master Plan for ICT Development for 2005–2010 adopted through Government Resolution No. 58 by the Party Politburo, the creation of the National Steering Committee for ICT headed by the deputy prime minister, and the creation of a new Ministry of Information and Communication.

More recently, with the country's adoption of an open door policy leading toward international economic integration and modernization and industrialization by 2020, ICT has once again been emphasized as a top priority among high technology initiatives. However, ICT has been seen more as an economic sector rather than as an enabler of development. Thus, until 2000 ICT development efforts tended to focus more on industrial production targets for hardware and software that were sometimes unrealistic. Since then there have been many improvements in ICT development in Vietnam.

TECHNOLOGY INFRASTRUCTURE

Keeping in mind the idea that a good ICT infrastructure is necessary to enable development, Vietnam is putting considerable effort into the modernization and expansion of its telecommunication system. Annual growth in the telecommunications sector is approximately 25 percent. In 2005–2006, Vietnam's ICT growth rate was double the average in Asia and triple the world average expansion rate. New technologies such as third generation (3G), fourth generation (4G), Worldwide Interoperability for Microwave Access (WiMAX), mobile television (TV), and Next Generation Networks (NGN) are being promoted and are becoming major trends in the development of Vietnam's tele-communications industry.

All provincial exchanges are now connected to Hanoi, Da Nang, and Ho Chi Minh City by fibre optic cable or microwave radio relay networks; main lines have been substantially increased; and the use of mobile telephones is growing rapidly. For international connections, there are landing points for the South East Asia–Middle East–Western Europe 3 cable system (SEA–ME–WE 3), and the Thailand–Vietnam–Hong Kong submarine cable systems. Also, the Asia–America Gateway submarine cable system, which is scheduled for completion by the end of 2008, will provide new access links to Asia and the United States (US). The satellite Earth Stations-2 (Intersputnik) continue to operate. Asymmetric Digital Subscriber Line (ADSL) services and broadband access are also being used to improve the quality of Internet access.

In rural areas the use of telecom services, particularly tele-phones, is improving. But the extent of Internet use is not the same among the regions, with 86 percent of Internet use concentrated in Hanoi and Ho Chi Minh City and limited use and poor connections in rural areas.

There are six telecommunications operators in Vietnam, of which two are regional with geographical restrictions on their operations and one is able to provide maritime communication services. Almost all Vietnamese telecommunication companies

are state-owned enterprises with minor private investment, and there is cross-ownership among carriers. Vietnam Post and Telematics (VNPT) is a major state-owned enterprise operating in almost all telecommunications fields except for maritime telecommunications, and it holds approximately 94 percent of the fixed telephone market and 72 percent of the cellphone market. Viettel is under the Ministry of Defense. It provides fixed line, long distance, and IP-based telecommunications services, as well as leased lines and mobile communications. EVN Telecom, which is wholly owned by the state-run Electricity of Vietnam Group, also provides fixed line, long distance and IP-based telecommunications services, leased lines, and mobile communications. Vishipel is a 100 percent owned subsidiary of Vietnam Maritime Corporation, which provides marine communications services. Saigon Postel Telecommunication Company (SPT) is the first enterprise to be equitized with a number of large shareholders, including VNPT, which holds 18 percent of the total shares. Hanoi Telecom is the first telecom carrier with private investment, and this company provides services for fixed lines in the Hanoi area only and long distance and Internet Protocol (IP) based telecommunications, leased lines, and mobile communications.

According to the Ministry of Post and Telematics, in mid-2008 Vietnam had about 38.8 million phone subscribers. Telephone access is currently available to all communes nationwide. As of 2007 the number of telephone lines in use was 10.8 million.

There were 2.7, 4.5, and 8.7 million people mobile phone subscribers in 2003, 2004, and 2005, respectively, indicating a two-fold increase every year. Between 2006 and 2007, the number of cellphone subscribers grew by 70 percent from 10 million to 17 million. In 2006, cellphone subscribers accounted for 61 percent of total phone subscribers. It is predicted that the number of cellphone subscribers will hit 20 million and 25 million in 2008 and 2010, respectively.

The market in Vietnam is currently divided among five cellphone network operators, with one new entrant planning to launch services soon. The market is dominated by the top three carriers Vinaphone, Mobifone, and Viettel Mobile, with approximately 4 million, 4.7 million, and 2.5 million subscribers, respectively. Hanoi Telecom will be the first to rollout 3G services as part of a project with Hutchison Telecommunications setting up a CDMA2000 3G mobile network valued at USD 655.9 million.

It is anticipated that EVN Telecom and Hanoi Telecom will bring a breath of fresh air into Vietnam's telecommunications market, although these two new cellphone carriers have not created any remarkable changes except for balancing the number of carriers using two different Global System for Mobile

communications (GSM) and Code Division Multiple Access (CDMA) technologies (i.e. three licenced mobile network operators are running or will operate GSM mobile networks operators, and three are running CDMA mobile networks). While there are now three CDMA networks, their development is rather weak and the number of subscribers is low. However, EVN Telecom and Hanoi Telecom use CDMA technology with advanced 3G capabilities (faster than GSM). This will certainly help them to become top carriers in the future. Currently, the telephone network of VNPT has over 6.3 million subscribers, of which 2.3 million are mobile phones. VinaPhone and MobiFone have nationwide coverage and roaming services in 50 countries. Vinaphone's 2.8 million subscribers and MobiFone's 1.7 million subscribers account for 42.34 percent of the total subscription.

In terms of Internet development, Vietnam ranks third in the world, with a 27.48 percent increase in the number of Internet users over the past four years (Gov3 2005). As of September 2008, the number of Internet subscribers in Vietnam stood at 3.86 million, of which there were 1,842,856 broadband subscribers (VNNIC 2008). The number of regular Internet users has been pegged at 20,454,873 people or 23.75 percent of the population. This is expected to reach 35 percent by 2010.

Broadband market demand has increased significantly. However, Internet distribution is not even, with 72.76 percent of Internet subscribers in the two cities of Hanoi and Ho Chi Minh. Seven other cities and provinces account for 10.48 percent, and the remaining 55 provinces account for only 16.76 percent. About a third (32 percent) of the communes has access to the Internet. In 2007, the number of Internet hosts reached 106,772.

By mid-2007, the total bandwidth to link Vietnam internationally was 8,703 Mbps, a 150 percent growth in 12 months. In 2008 there are 84,492 websites under .vn and 764,672 IP addresses. The total bandwidth for subscribers is 339,734 and the total leased line equivalent to 64 Kbps is 9,853.

Six companies are licenced IXPs and 13 are Internet service providers (ISPs). The largest ISPs in 2006 were VNPT with 43 percent of the market, FPT Tel with 24 percent, and Viettel with 18.61 percent. The new ISPs include Hanoi Telecom, OCI (One-Connection Internet Service Joint Stock Company), and Tienet (Trade Import Export Company — TIE).

Currently, all 64 provinces and cities have completed a program of Internet development in universities, colleges, and schools. Most government organizations and agencies at the central and provincial levels have access to the Internet. Half of secondary schools and provincial hospitals are networked, while 92 percent of companies are linked to the Internet.

In May 2006, US-based Lockheed Martin and VNPT were awarded a USD 168 million contract to supply Vietnam's first communications satellite. Vinasat, as the satellite is called,

was launched in April 2008, and it is expected to provide roughly 15 years of service. It will provide broadcast and tele-communications service (video, data, voice) to the Asia Pacific region. With its first telecom satellite, Vietnam expects to save the tens of millions of dollars paid each year by Vietnamese state-owned firms to foreign satellite operators for use of inter-national channels.

The improvement of infrastructure has strategic importance not only for economic and business users. With Vinasat, most of the poor farmers along the Mekong River will receive free broadcast of more than 10 new TV channels.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

In August 2007 a new Ministry of Information and Communication was created through the merger of the Ministry of Post and Telematics with some units of the Ministry of Culture and Information. There is also a new National Steering Committee for ICT headed by the deputy prime minister. The Committee is expected to assist the Prime Minister in overseeing ICT development and to play a key role in cross-cutting and inter-ministerial coordination of ICT issues.

ICT-related activities are also being implemented by other ministries, such as the Ministry of Science and Technology (MOST). Also in 2007 the Ministry of Trade was merged with the Ministry of Industry to become the Ministry of Industry and Trade (MOIT), with responsibility for developing e-commerce. Training and education in ICT is organized by the Ministry of Education and Training (MOET).

ICT is likewise being promoted by several organizations outside of government. Within the Central Committee of the Communist Party, there is a Committee for Science and Edu-cation that is concerned with ICT-related matters. The National Assembly also has a Committee for Science, Technology, and Environment that proposes various ICT-related legislative activities.

Several non-government organizations also play a key role in ICT development. The Vietnam Association of Informa-tion Processing (VAIP), Hanoi Association for ICT, Ho Chi Minh City Computer Association (HCA), Vietnam Association of Electronics Enterprises, Vietnam Software Association (VINASA), and Vietnam Chamber of Commerce and Industry (VCCI) are very active and they work closely with the govern-ment in ICT initiatives. In 2007, a new association called the Vietnam e-Commerce Association (VECOM, www.vecom.vn) was created to promote e-commerce.

ICT AND ICT-RELATED INDUSTRIES

The Vietnam ICT market in 2006 was valued at USD 1.15 billion, representing a year-on-year growth of 22.6 percent. Hardware accounted for USD 730 million while software and services accounted for USD 285 million.

The hardware industry includes production of PCs, tele-com equipment, electronics products, and components. Some Vietnamese companies have manufactured and assembled PCs from imported SKD components. Some have cooperated with foreign enterprises in assembling computers with brand names from Vietnam such as CMS, SingPC, Mekong Green, VINACom, T&H, Robo, Elead, and others. The production of other tele-com equipment such as switch systems has been increasing. In 2006, the hardware industry reached a turnover of USD 1.38 billion, of which USD 1.233 billion came from exports and USD 147 million from the domestic market.

Several multinational companies have begun to increase their investment in the ICT market. One of the most import-ant is the Intel investment in Ho Chi Minh City of more than USD 500 million. Among the largest producers and exporters are companies like Canon or Fujitsu.

The software industry in Vietnam is being developed mainly by small groups with a staff of 20–30 experts who focus on deal-ing with Vietnamese requirements and carrying out software services. There are around 6,000 software firms in operation, with a total of 15,000 employees. There are nine software parks in Vietnam. Subcontracting software for export in 2006 reached USD 360 million, representing a 44 percent growth compared to 2005. Of the 2006 total, USD 255 million (70.1 percent) was from the domestic market and USD 105 million (29.9 percent) was from exports. The value of the software industry in 2007 is USD 498 million.

Vietnam's content industry is just starting out, with some discussion of digitizing all archive and library materials available in written formats and a government program to develop digital content.

Venture capital is taking an interest in the ICT industry. IDG Ventures Vietnam, the country's first technology venture capital fund, has already taken a stake in more than 25 local ICT companies. IDG Ventures Vietnam has also helped to popularize many local websites, including the music site www.yeuamnhac.com, e-markets http://chodientu.vn and www.sanotc.com, and stock market information site www.Vietstock.com. DFJV, another technology venture capital fund that is a joint venture of VinaCapital and Draper Fisher Jurvetson, invested more than USD 15 million in eight domestic companies during the past year.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Several key ICT-related policies were promulgated in 2005–2006, such as those supporting enterprises in the application of ICT and serving the need for integration and development in 2005–2010, calling for the development of a master plan to develop e-commerce in 2006–2010, targeting development of ICT in Vietnam until 2010, and developing telecommunications and the Internet in Vietnam until 2010.

In 2007 new policies were adopted to further enhance ICT development in Vietnam. Resolution No. 51/2007 to develop the software industry until 2010 was issued. The resolution adopts a more practical approach and realistic targets for the software industry. Decree No. 71/2007 targets the development of the ICT industry in general. Resolution No. 6/2007 calls for the development of the content industry up to 2010.

The private sector is working with the government and taking an active role in the implementation of these resolutions. Still, due to limited resources, ICT efforts at the grassroots level, especially in the rural areas, tend to be less active than in large cities like Hanoi, Ho Chi Minh City, or Danang.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT

ICT-related laws that took effect in 2006 include the law on electronic transactions, the law on information technology, the law on IPR that has a special section on software development, and the decree on e-commerce. As such, it can be said that 2005–2006 was when a strong legal foundation for ICT development was laid in Vietnam.

To concretize these laws and decrees, more specific regulations were enacted in 2007. The more notable among these are:

- The regulation regarding financial management of funds for public telecom services;
- Directive No. 04/2007 enhancing the protection of copyright on software;
- Decree No. 26/2007 on digital signatures;
- Decree No. 35/2007 on electronic transactions in banking; and
- Directive No. 03/2007 enhancing information security over the Internet.

These laws and regulations clarify the legal parameters and thus encourage e-commerce and e-business activities. They help in the resolution of legal disputes and other potential problems that are new and unfamiliar. One example is the law on ICT that clearly regulates the rights and responsibilities of individuals and organizations in the ICT industry, human resource development in ICT-related fields, and ICT-related research and development (R&D). The law also specifies incentives for developing the ICT market for key products and services and ICT special zones.

To promote specific ICT-related thrusts, some resolutions have been put forward, such as Resolution No. 52/2007 on the implementation of e-customs services. In addition, the Law on Telecommunication is being drafted and should be passed by the National Assembly in 2010.

DIGITAL CONTENT INITIATIVES

The Ministry of Information and Communication has drafted a master plan for digital content development. The target is for the digital content industry to earn about USD 400 million in revenues by 2010. To this end, some 300,000 content industry experts will be trained. The industry will include key activity areas such as e-learning, games (online, interactive and mobile), online publications, content development for the Internet, digital libraries, digital film and multimedia, and other value added services (VAS). At present there are about 400 enterprises working in the content industry and they are concentrated in Hanoi and Ho Chi Minh City.

On 3 May 2007, the government signed Decision No. 56/2007/QD-TT to ratify the development of the digital content industry. The digital market is beginning to draw the attention of some large companies. In 2007 Yahoo entered the Vietnamese market with several services in Vietnamese, such as Yahoo!Mobile gate, Yahoo!messenger, and Blog 360 and 360 Plus. Microsoft and Google are also targeting the Vietnamese market. Smaller Vietnamese players have started social communities and networks such as Blog Viet, Young Generation, and Bamboo.

However, much remains to be done to ensure that digital content in the Vietnamese language is available for citizens to use (see 'Challenges in Internet Use of S&T Staff in Rural Communes in An Giang).

ONLINE SERVICES

e-Government

The program to computerize state management, called Program 112, aimed to link central government offices in Hanoi and ministries to provincial offices for day to day management and data transfer. However, due to fiscal mismanagement, the

Challenges in Internet Use of S&T Staff in Rural Communes in An Giang

In 2002, An Giang province started a project to improve the capacity to access the Internet of S&T staff working in rural communes. About 42 points of rural Internet access were established: seven points in communal cultural and post office centres, nine points at post offices of district centres, and 26 points in offices of the People's Committee in the communes. S&T staff working in the communes were trained to use computers and access the Internet by the An Giang University and the Department for Science and Technology (DOST).

The project had an initial total investment of around USD 30,000 from the provincial budget. Of the 114 S&T staff being trained, 109 received club membership and Internet access cards from VNN (each card cost VND 100,000 or around USD 6). According to the IT Center of the provincial DOST, there are now around 40 S&T staff using the Internet in 20 communes and small towns of the province.

Still, there are several constraints. First, the use of email is charged the long distance fee of VND 800 per minute, instead of VND 120 as promised for those with access cards. Second, the access points are available on a very limited basis. Because post offices are closed outside of office hours, 26 People's Committee offices were designated as the Internet access points. But the lack of telephone lines and machines (there are only two telephones for each office) prevents users from accessing the Internet. The machines are available for Internet use only at night, after office hours, when it is not very convenient for people to come. Third, there is a lack of Web-based information in the Vietnamese language, especially information related to science, technology, agricultural economics, and the like. Information relevant to the issues confronting the farmers in the communes is simply not available on the Internet. This seems to be the most difficult problem to surmount in the near future.

(Source: Tran 2003)

program was suspended in 2007. As a separate initiative, the government has started its own website (www.gov.vn) with three functions: to create an electronic database of government activities; to communicate government policies; and to set up a forum for exchanges between government, its agencies, and enterprises and the population at large. The overall aim is to perfect the provision of public services to citizens. This initiative is expected to compensate for the failure of Program 112.

e-Commerce

According to the Ministry of Industry and Trade (MOIT), by the end of 2004 there were 17,500 enterprises (nearly 20 percent of the total) with websites. By the end of 2007, 38 percent of enterprises had websites. Almost all enterprises have access to the Internet, most via an ADSL connection.

e-Transactions and e-payments have become a popular mode of operation particularly in booking airline tickets. Most enterprises also participate more actively in the e-market and there are several state-run portals to support enterprises in doing e-business. In addition to the national e-commerce portal ECVN (www.ecvn.com), the MOIT runs a program called TrustVn (www.trustvn.gov.vn) to rank the credibility of e-commerce websites. Other e-commerce formats such as business-to-business (B2B), with around 40 e-marketplaces

in 2007, and business-to-consumer (B2C) — www.25h.vn is the most successful case — show steady growth (see 'Village e-Commerce in Bat Trang Village, Hanoi, Vietnam').

The legal framework for doing e-business became more comprehensive with the introduction of a range of regulations in 2007 (see 'Legal and Regulatory Environment for ICTs').

e-Banking

Among the most active online services is e-banking, which includes Internet banking, mobile banking, home banking, phone banking, and e-payment services. Home banking (payment of bills and money transfer over the Internet) and payment of salaries and pension funds over the Internet were introduced in 2006. According to new rules, pensioner and government officials should get a personal account and a card to receive payment. Ten banks that account for the largest number of automated teller machines (ATMs) are participating in this scheme.

The domestic bank card market grew a staggering 137 percent in 2007 relative to the previous year, as more Vietnamese have switched to using plastic to pay for goods and services. Central Bank figures indicate that commercial banks nationwide issued more than 8.28 million debit and credit cards in 2007, more than double the 3.5 million cards issued in 2006. This means one card for every 10 people. Card transactions now account for 6 percent

Village e-Commerce in Bat Trang Village, Hanoi, Vietnam

Bat Trang is a ceramics-producing village where family-based traders and craftsmen use the Internet to engage in e-commerce. The village is about 10 kilometres north of Hanoi. It has 6,692 inhabitants in 1,600 households. The ceramic makers have been using information technology since the beginning of 2000. Initially they used email and the Internet as a cheaper and faster means of connecting with buyers. Then some enterprises built websites to advertise their products to foreign markets. After some successes, other enterprises recognized the advantage of using the Internet. Now 15 percent of households in Bat Trang have computers and all have telephones. And many enterprises are trying to build their own websites with the help of computer companies and university graduates.

To help the enterprises, the Council of the Commune coordinated with a computer company in Hanoi to provide a computer skills course consisting of three two-hour sessions per week for six weeks. The company supplies four computers and charges VND 150,000 (about USD 8) per course per participant. At present, there are 60 learners finishing the course. Many households are also learning English and they have formed groups to hire English teachers.

(Source: Tran 2005)

of the total non-cash payments in the economy. Local debit cards have the biggest market share, making up 93.87 percent of the total number of cards issued by banks, followed by international debit cards (3.65 percent), international credit cards (2.22 percent), and domestic credit cards (0.31 percent). There are currently 32 banks issuing about 130 brands of cards, and 54 percent of them are domestic. There are several card alliances in operation, such as Smartlink, VNBC, and banknetvn.

By the end of 2007, Vietnam had 4,300 ATMs and over 23,000 point of sale (POS) terminals, up from 2,500 and 14,000 in 2006 respectively.

Other Online Services and Business

After the boom in 2006, online gaming services have remained on course. This sector has created some concerns among families about young people neglecting their studies due to addiction to online games, and gambling, cheating, and other related crimes. To address the situation, in June 2006 several government agencies (on ICT, culture, the police) issued Joint Document No. 60/2006 regulating the production, supply, and use of online games in the country.

e-Learning is another active online services segment. Vietnam Open Courseware (VOCW, www.vocw.edu.vn), run jointly by the MOET, VASC Software and Media Company, and Vietnam Education Foundation, is the most notable program.

EDUCATION AND CAPACITY-BUILDING

Following Decision No. 331/QD-TTg (6/4/2004) launching a program to develop human resources for the ICT industry until 2010, and other efforts to pursue more training of ICT

staff[1] up to 2007, the number of personnel with ICT skills has grown significantly. Vietnam has about 35,000 people working in the software industry, more than 20,000 in the content and services industry, and nearly 100,000 in the hardware industry. In addition, there are about 100,000 people working in telecom firms and 90,000 specialized ICT staff working in ministries, agencies, and enterprises.

There have been some important changes in ICT human resources development, such as ICT training in English by all universities, more focus on ICT training, and changes in the accreditation and degree granting system for ICT, among others. Private universities specializing in ICT training have come into operation in the last two years, such as the FPT University in Ho Chi Minh City. In 2007, there were more than 200 universities and colleges providing ICT training to more than 10,000 recruits per year.

Despite the numbers, the supply of ICT personnel is still lagging behind the demand. In software, for instance, only about 47 percent of demand is being met by training. The quality of training is another big issue, with more than half of the graduates needing to be retrained by firms before they can be properly placed.

Large multinationals are providing additional training and capacity-building. One example is IBM with its KidSmart program providing schools and kindergartens in all 64 provinces of the country with specially designed computers for learning. About 1,200 teachers have been trained under the program. IBM has also introduced a Service Science, Management, and Engineering (SSME)/IT Services Curriculum (ITSC) to Vietnamese universities in collaboration with the MOET and MOST. Intel is cooperating with US universities to open training facilities and Oracle has started implementing the Oracle Academy program in Vietnam.

OPEN SOURCE/OPEN CONTENT INITIATIVES

As a result of Decision No. 235/QDD-TTG, which seeks to foster the application and development of open source software (OSS) in Vietnam over a four-year period (2004–2008), many new OSS products have been introduced to users. The MOST has conducted an OSS awareness raising campaign and the OSS Forum is an active movement. Vietnam became a member of Asianux in 2007 and an OSS Center is to be set up in Hanoi. Linux Server 3.0 was introduced around the end of 2007. In addition, another OpenLab was set up in Ho Chi Minh City to do research, testing, evaluation and technical services, training, and packaging of products. One example of an OSS-based effort is a PC operating system costing USD 2. Some local companies are cooperating with Intel to introduce cheap PC-based OSS.

The National Center for S&T Information is creating a database of OSS activities and products. There are more than 30 companies now involved in the supply of OSS-based products and services.

Some government organizations and commercial banks, as well as some schools and universities, have shifted to OpenOffice. However, the impact of OSS in Vietnam is still limited and the rate of development is slow, despite the push by some government agencies.

ICT RESEARCH AND DEVELOPMENT

State-run R&D is being done on embedded systems, networks, information security, and GIS applications for chip design. Apart from the MOST program that tends to focus on key laboratories and research institutes, R&D is taking place in many ICT faculties and centres in universities.

One of three most notable R&D events in 2007 was the design and creation of the first 'made in Vietnam' 8-bit RISC chip SigmaK based on TSMC technology by a research centre of the Vietnam National University (IC Design Research & Education Center, or ICDREC) in Ho Chi Minh City. Thereafter the Vietnam Semiconductor Manufacturing Company launched the 'energy saving management' chip VS8801A. This marks the beginning of collaboration in chip-making between local R&D companies and Vietnamese companies overseas. Some attempts to commercialize this R&D product are being pursued in selected markets like Taiwan and the US, which shows that ICT R&D activities are beginning to have a market orientation.

CHALLENGES

Overall, the development of ICT in Vietnam is unfolding at a steady pace. Thanks to government efforts as well as public-private partnerships, ICT development has a more firm legal basis and institutional policy support, leading to better performance of ICT industries and applications.

But there have been recent setbacks, notably the stoppage of Project 112 aiming to connect all agencies to a single network. The quality of telecom and Internet services is another concern, with Ministry of Past and Telematics' recent findings that some of the largest providers are providing services of a quality that is below industry standards.

Although in general the ICT picture in Vietnam looks better than before, the notion of ICT as a development enabler is not widespread. There is a need for a change of attitude at all levels and all layers of society to make Vietnam a more open and transparent ICT-friendly society.

Finally, in spite of various efforts to encourage more competition, the mighty monopoly of VNPT remains. In the context of joining the World Trade Organization, Vietnam will have to face the challenge of foreign players demanding a more open domestic market in telecoms as well as in other ICT services.

NOTE

1. These include Resolution No. 05/2005/NQ-CP promoting socialization activities such as education, culture, healthcare, and sports; the Law on Education passed by the National Assembly in 2005; and Regulation No. 14/2005/QD-TTg on the development of private universities.

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Thein Oo is the President of the Myanmar Computer Federation (MCF) and Chairman of the Myanmar Info-Tech Corporation Ltd, which builds ICT parks and is the key facilitator for ICT industry development in Myanmar. He is also the Secretary of the Myanmar Natural Language Implementation Committee, Chairman of the Working Group for Natural Language Processing Standards and Applications, and Chairman of ACE Data Systems Ltd, the leading software house in Myanmar. He is, likewise, a member of the Electronic Transaction Law Implementation Central Committee, Myanmar National Digital Broadcasting Committee, and the Board of Study of Yangon University and Yangon Institute of Economics, where he is a part-time lecturer of MBA and Master of Public Administration courses. In 2005–2007, Mr Oo served as the Chairman of the ASEAN Working Group for Universal Access, Digital Divide, and e-Government.

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Samuelu Taufao is the ICT Manager for the Western and Central Pacific Fisheries Commission (WCPFC). From 2001 to early 2008, he was the IT Manager for the Secretariat of the Pacific Community, working closely with PIFS in the implementation of the Pacific Plan's Digital Strategy. Samuelu has worked for more than 20 years in the ICT sector in the Pacific, with special interest in the needs of people in remote and rural Pacific communities. He coordinated the Rural Internet Connectivity (RICS) and One Laptop per Child (OLPC) projects in the Pacific region, and he continues to provide technical advice at country-level. In 1999 he founded the Pacific Islands Chapter of the Internet Society (PICISOC), which is now one of the largest and most active chapters of the global Internet Society. Samuelu was born in Samoa. He has a BS in Mathematics from the University of

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Index